THE IMPACT OF CURIOSITY ON LEARNING DURING A SCHOOL FIELD TRIP TO THE ZOO

By

KERRY ANN CARLIN

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1999

LOVINGLY DEDICATED TO THE MEMORY OF

John J. Koran, Jr.

ACKNOWLEDGMENTS

This dissertation would not have been possible without the guidance, support, and encouragement of John J. Koran. He inspired me to pursue this path and it was with loving thoughts of him that I finished.

Special thanks go to Mary Lou Koran and Mary Grace Kantowski for co-chairing my supervisory committee and seeing me through to the end. My other committee members M. David Miller, Linda Behar-Horenstein, and Susan K. Jacobson, provided invaluable advice and guidance throughout this study.

This study would not have been possible without the assistance and participation of the teachers, staff and students of the Robinson Challenge Elementary School. Special thanks go to Susan Howell for her initial interest in the project and her coordination of testing schedules.

I am indebted to Betty Dunckel Camp for all of the help, advice, and guidance she has provided me over the years, especially while working on my dissertation. I am grateful that I had Anne E. Donnelly as an understanding and supportive boss and friend.

My family Theresa, Michele, Joe, and Helen, deserve special thanks for the support and reassuring words they provided through many years of schooling. I truly appreciate my fiancé, Michael, who has been patient, supportive, and encouraging, especially through the rough times.

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

THE IMPACT OF CURIOSITY ON LEARNING DURING A
SCHOOL FIELD TRIP TO THE ZOO

By

Kerry Ann Carlin

August 1999

Chairperson: Mary Grace Kantowski
Major Department: Instruction and Curriculum

This study was designed to examine (a) differences in cognitive learning as a result of a zoo field trip, (b) if the trip to the zoo had an impact on epistemic curiosity, (c) the role epistemic curiosity plays in learning, (d) the effect of gender, race, prior knowledge and prior visitation to the zoo on learning and epistemic curiosity, (e) participants' affect for the zoo animals, and (f) if prior visitation to the zoo contributes to prior knowledge.

Ninety-six fourth and fifth grade children completed curiosity, cognitive, and affective written tests before and after a field trip to the Lowery Park Zoo in Tampa, Florida. The data showed that students were very curious about zoo animals. Dependent T-tests indicated no significant difference between pretest and posttest curiosity levels. The trip did not influence participants' curiosity levels. Multiple regression analysis was used to determine the relationship between the dependent variable, curiosity, and the

independent variables, gender, race, prior knowledge, and prior visitation. No significant differences were found.

Dependent T-tests indicated no significant difference between pretest and posttest cognitive scores. The field trip to the zoo did not cause an increase in participants' knowledge. However, participants did learn on the trip. After the field trip, participants identified more animals displayed by the zoo than they did before. Also, more animals were identified by species and genus names after the trip than before. These differences were significant ($\alpha = .05$).

Multiple regression analysis was used to determine the relationship between the dependent variable, posttest cognitive performance, and the independent variables, curiosity, gender, race, prior knowledge, and prior visitation. A significant difference was found for prior knowledge ($\alpha = .05$). No significant differences were found for the other independent variables.

Chi-square tests of significance indicated significant differences ($\alpha = .05$) in preferences for types of animals and preference for animals by gender. Significant differences ($\alpha = .05$) were also found between the reasons why animals were preferred. Differences occurred between animals that were liked and disliked, between genders, and between the pretest and the posttest.

CHAPTER 1
INTRODUCTION

Purpose

The objectives of this study were to (a) investigate differences in cognitive learning as a result of a zoo field trip, (b) examine the effect of a field trip on epistemic curiosity (c) examine the impact of curiosity on learning, (d) investigate the role prior knowledge plays in curiosity and learning from a field trip, (e) investigate the role of learner characteristics (gender, race) in learning and curiosity, and (f) investigate participants' affect for different zoo animals. If it can be demonstrated that the expression of curiosity facilitates learning, zoo educational programs can be designed to foster curiosity.

Statement of the Problem

Museums and zoos are institutions in where education and learning are often expected outcomes (Ellis et al., 1991). In order to learn in these informal settings, visitors must be attracted to and attend to the information being presented in exhibits (Shettel et al., 1968).

Curiosity is considered an important attribute and an influencing factor with respect to learning (Harty & Beall, 1985). Curiosity is a prerequisite to learning, problem solving, reasoning, and social-intellectual competency (Bradbard et al., 1988). "Curiosity

is an attribute frequently cited as important for scientific exploration and one which is closely related to concept attainment" (Koran et al., 1989 p. 405). "Studies that concern the role of curiosity in arousing conflict and its internal cognitive processes, in encouraging inquiry, and in fostering motivation indirectly imply that curiosity may be the factor that stimulates learning" (Fire 1985, p. 19).

Curiosity is an affective variable that can influence learning in two ways. It can be a response to a stimulus or it can act as a stimulus. When curiosity is the response to a stimulus, it functions to encourage people to use their senses to attend to the stimulus. The curiosity response also acts as a stimulus which influences attention, expands perception, and enhances encoding. Aroused curiosity should direct a visitor's attention to exhibits and increase learning (Koran & Koran, 1986b).

There have been many researchers who have investigated and defined curiosity (Berlyne, 1954; Kreitler et al., 1975; Lowenstein, 1994; Maw & Maw, 1964; Peterson & Lowery, 1972; Sussman 1989). This study will examine epistemic curiosity. Epistemic curiosity is defined as the search for knowledge that is brought about by a conceptual conflict.

The literature describing the role of curiosity in informal settings is sparse. Koran et al. (1984) conducted a study in a museum and investigated the role curiosity played in increasing visitor attention to an exhibit. Peterson (Peterson & Lowery, 1972; Peterson, 1979) looked at curiosity with manipulatable objects in a museum-like setting. Gottfried (1980) used a psychomotor scale to record children's curiosity behavior in a museum. All three of these studies primarily investigated psychomotor curiosity. None explicitly investigated the role of epistemic curiosity or the effect of curiosity on learning

outcomes. Additionally, there has been no research assessing any type of curiosity in a zoo.

Marsh (1978) conducted a study that investigated the role of epistemic curiosity in a museum. Marsh investigated the level of epistemic curiosity expressed through question-asking during visits to an art museum. Certain methods of conducting talks during docent tours increased the amount of question-asking or epistemic behavior. However, this study did not investigate the impact of this increased curiosity on learning outcomes.

Children can be categorized as high-curious or low-curious depending on their response to novel or complex stimuli. Highly curious children will probably perform better on cognitive tasks than children who are less curious. This is because high-curious children tend to explore objects and events with a greater number of their senses and for longer periods of time, which provides more cues for encoding and longer periods of time for encoding to occur. Therefore, high-curious students should understand better what they are experiencing, remember it better, and have more complete concept learning (Koran & Longino, 1982). In order to explore this possibility, an objective of this study is to determine the impact various levels of curiosity have on learning from a field trip.

Many zoo educators feel the need to produce a lasting positive attitude in their visitors that may in turn lead to a beneficial behavior toward wildlife. One indicator of an individual's attitude toward an animal is whether the individual feels he/she likes or dislikes the animal. There has been a consistency in results demonstrating that many people like and dislike certain specific types of animals (Bart, 1972; Collins, 1976; Morris, 1960; Surinova, 1971; Westervelt & Llewellyn, 1985). For example, mammals

and large animals are favored among children and young adults. Animals that are unpopular are predators, small animals, and cold-blooded animals (i.e., snakes). However, most of these studies have been done with adults. More research is needed to document children's preferences. The current study will document animals that children report to like and dislike. Some research has shown that gender and race may have an effect on children's attitudes toward and knowledge about wildlife. Therefore, gender and race will be investigated as variables that may affect whether or not an individual likes certain types of animals.

During a learning experience individuals seek relationships between their own knowledge/experiences and the content/structure of new information. It has been shown in previous research in formal learning situations that prior knowledge is an important factor for future learning. In informal settings as well, individuals will interpret the information being presented using their own background experience, knowledge, and interests. Prior knowledge will be a variable considered in the current study because a student's prior knowledge of the material being covered may influence what he or she subsequently learns. The student's prior knowledge will be taken into consideration to determine if it helps learning and if different amounts of prior knowledge influence the amount of curiosity expressed by the students.

Significance of the Study

An important primary goal for many zoos is educating their visitors. Research that focused on the behavior and over-all experience of the zoo visitor has been conducted. However, little attention has been paid to what visitors learn (Braverman & Yates, 1989). Much of the research that has been done on visitor learning is based on

self-report posttests (Birney & Shaha, 1982; Schnackenberg et al., 1997). A more thorough investigation of what concepts zoo visitors learn during a visit is needed.

In addition, most of the studies done in informal settings have been conducted in museums. Research on education in zoos is "extremely sparse" (Bixler, 1995). The research found is mostly qualitative and descriptive, for example, tracking the movements of visitors through the zoo or recording demographics (Bixler, 1995). Zoo personnel must therefore rely on very little research to guide their efforts.

An understanding of learning in informal settings will be of limited scope if the majority of the research is conducted only in museums. Previous research (Ceci & Bronfenbrenner, 1985; Garner, 1990) has shown that different settings (e.g., laboratory and home) affect the type of cognitive strategies that individuals use. There are also systematic differences in the behavior of individuals from one setting to another. Hence, there should be expected variations in learning and strategy use across settings (Garner, 1990). The differences in museum and zoo settings may elicit different strategy use thereby affecting if and what visitors learn in the different settings. Individuals presented with similar information may extract different ideas from the information and form a different understanding based on the setting. This further supports the need for more studies on learning outcomes in a zoo environment.

Curiosity has frequently been cited as a factor that can lead to increased learning (Fire, 1985; Koran et al., 1989; Messick, 1979). However, little research has been done with respect to curiosity and learning beyond the preschool years (Rotto, 1994). Inagaki (1978) showed that for kindergarten children there is a high correlation between curiosity and amount of information gained. In addition, Alberti & Witryol (1994) have shown by

examining performance on a novelty task and achievement scores that for third and fifth graders there is a positive correlation between curiosity, motivation and cognition. However, there has been little direct observation of learning outcomes as a product of curiosity in any setting.

Curiosity has been proposed as an important factor in learning from exhibits in informal settings (Koran & Koran, 1986b). Perry (1993) has identified curiosity as one of six psychological needs of museum visitors. However, little research has actually been conducted to document the effect of curiosity in informal learning and no research studies done on curiosity in a zoo environment were found. This study is designed to investigate the relationship between different levels of curiosity and learning in the zoo as an informal setting. Information gathered on the extent to which curiosity facilitates learning can be used as a basis for designing educational programs.

A significant contribution of this study to the informal setting field is the instrument that has been designed. The current instrument was adapted from an instrument used to measure specific epistemic curiosity for different learning situations. The current instrument was designed specifically for a zoo learning experience and for a young audience. This instrument can be used as a quick assessment of a zoo program's impact on curiosity. Since curiosity is an important factor in learning and for future interest in and exploration of a subject, zoos may be interested in using the instrument as a measure of the success of their programs.

CHAPTER 2
REVIEW OF LITERATURE

Koran & Koran (1986a) developed a framework that was used as a guide for exploring the variables that were examined in this study (Figure 2-1). The framework was adopted from cognitive psychology and based on the work of Bransford (1979).

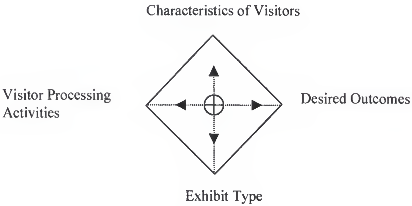

Figure 2-1. Framework for Informal Setting Educational Research (Koran & Koran, 1986a)

This framework considers four categories of variables and their interactions when investigating learning in an informal setting. The visitor or participant is represented by the "O" in the center of the figure. Characteristics of visitors include age, sex, knowledge, attitudes, and curiosity. Visitor processing activities include attention, encoding, memory storage, retrieval, and other processing and storage activities. Characteristics of the exhibits for zoos include style of exhibit, size of exhibit, and

number of animals. Desired outcomes can be gains in knowledge, curiosity, and motivation.

This research is concerned with the following visitor characteristics: levels of curiosity expressed, prior knowledge, prior visitation to the zoo, gender, and race. The visitor processing activities of importance to this study are information storage and retrieval – what do the children learn and remember from their experience. Learning during the field trip and a gain in curiosity are the desired outcomes.

The purpose of this chapter is to review the literature on visitor characteristics and visitor processing activities investigated in the current study.

Curiosity

Curiosity and Novelty

Berlyne is considered one of the pioneers of curiosity research (Harty & Beall, 1984). His theory of curiosity is the basis for much of the research found in the literature. Berlyne (1954) proposed that curiosity is a state of arousal brought about by stimuli and uncertainty in the environment leading to exploratory behavior.

According to Berlyne, the motivating power of a stimulus depends on its properties. Berlyne proposed that these properties be called collative variables and that they include novelty, complexity, surprise, ambiguity, and incongruity (Berlyne, 1978). He called them collative variables because they induce comparison and integration of information by an individual (David & Witryol, 1989).

Novelty is the most thoroughly studied and understood collative variable. A considerable amount of research has been conducted which demonstrates that novelty does stimulate curiosity (David & Witryol, 1989; Henderson & Moore, 1980; Paradowski, 1967; Rabinowitz, et al., 1975; Smock & Holt, 1962). Individuals from all age groups have shown a preference for objects or situations that are novel (Koran & Longino, 1982).

The Witryol laboratory (David & Witryol, 1989) has consistently shown the motivational effects of short-term novelty and developmental invariance in the preference for increasing levels of this variable. Their studies have shown the effects of novelty among children in nursery school through grade 5. Hutt (1970) and Nunnally & Lemond (1973) also have shown that children explore more when provided with novel objects.

Paradowski (1967) conducted a study on incidental learning using pictures of common (familiar) animals and unusual animals. He found that subjects spent significantly more time observing the pictures of the unusual animals. Under the novel animal condition, there was a significant improvement in intentional learning. In a lab condition, novel animals stimulated curiosity and held an individual's attention. This increased attention had a positive effect on learning.

Berlyne distinguishes between types of novelty. According to him, there is short-term novelty, which is the property of differing from what has been experienced during the previous few minutes. Long-term novelty is a contrast with anything that has ever been experienced (Berlyne, 1978). Nunnally & Lemond (1973) have a similar typology for novelty. One type of novelty consists of an abrupt change in a repetitive sequence of stimulation (short-term). A second type of novelty consists of a familiar object in an

unfamiliar place. The third type occurs when a person encounters an entirely new object (long-term) (Nunnally & Lemond, 1973). It is possible for either short-term or long-term novelty to occur in a zoo.

Views of Curiosity

There are many theories of curiosity, but researchers generally agree that curiosity represents a broadly conceived exploratory behavior. Exploratory behavior is considered the process by which novel stimuli are attended to and investigated (Sussman, 1989). However, other than that agreement there are many different definitions of curiosity (Engelhard & Monsaas, 1988).

Similar to Berlyne, Sussman (1989) described curiosity as "the internal state of the child who experiences perceptual-cognitive uncertainty generated by the presence of new and unanticipated stimuli" (p. 250). Lowenstein (1994) defines curiosity as a form of cognitively induced deprivation that results from the perception of a gap in one's knowledge.

Maw and Maw (1964) suggested that individuals exhibit curiosity when they (a) react positively to new, strange, incongruous, or mysterious elements in the environment by moving toward them, exploring them, or manipulating them; (b) exhibit a need or a desire to know more about themselves and /or their environment; (c) scan their surroundings seeking new experiences; or (d) persist in examining and/or exploring stimuli in order to know more about them.

Koran et al. (1984) operationally defined curiosity based on Maw and Maw's description. According to them, a curious individual exhibits the following behaviors:

scans the environment for novelty, approaches an object or event, interacts with the object, and then persists in this behavior. Similarly, Peterson & Lowery (1972) defined curiosity as coordinated sensory-motor responses directed toward objects in the environment. They recorded three different levels of curiosity: (a) a subject approaches an object without touching it, (b) a subject approaches and manipulates an object without reorganizing its parts, (c) a subject approaches, manipulates and reorganizes an object or its parts.

One reason there are so many definitions of curiosity is that it is not a unitary construct (Arnone & Small, 1995; Henderson & Moore 1979). Curiosity can be expressed in numerous ways. Berlyne (1954) distinguished between different types of curiosity on two different dimensions. The first dimension spans from specific to diversive curiosity. Specific curiosity refers to the desire for a particular piece of information. Diversive refers to the more general seeking of stimulation. Diversive exploration is a response to boredom and the seeking of change or stimulation (Lowenstein, 1994).

According to Berlyne (1966a), different physiological mechanisms underlie and mediate specific and diversive curiosity. Specific curiosity is motivated by a need to reduce arousal and to find the information that will reduce conceptual conflict. Diversive curiosity is motivated by a need to increase arousal, the seeking of stimulation or change. The curiosity that motivates learning and is the most relevant for the present study is specific curiosity.

Berlyne's other dimension extends between perceptual and epistemic curiosity. "Perceptual curiosity refers to a drive which is aroused by novel stimuli and reduced by

continued exposure to these stimuli" (Lowenstein, 1994, p.77). Epistemic curiosity refers to the desire for knowledge. Kreitler et al. (1975) conducted a factor analysis on curiosity behavior and found support for five factors of curiosity that included manipulatory, perceptual, conceptual, curiosity about the complex, and adjustive-reactive curiosity. The perceptual and conceptual factors support the use of Berlyne's distinctions of curiosity types for investigation.

Epistemic Curiosity

Berlyne (1954) defined epistemic curiosity as an exploration of symbolically representable contents aimed at increasing one's knowledge. It is usually stimulated by a thought-provoking experience that contradicts expectations and leaves an individual perplexed. Conceptual conflict or the simultaneous existence of two incompatible ideas in one's mind causes epistemic curiosity (Lowry & Johnson, 1981).

Epistemic behavior, the result of epistemic curiosity, refers to behavior whose function is to equip the organism with knowledge (McGuire & Rowland, 1966). Asking questions is one of the main expressions of epistemic curiosity or is a type of epistemic behavior. Asking questions has the function of reducing subjective uncertainty as quickly and as effectively as possible (Moch, 1987). According to Berlyne, understanding will tend to eliminate conceptual conflict and will reward the student by alleviating the tension associated with anxiety over missing or contradicting information (McGuire & Rowland, 1966).

The immediate cause of exploratory behavior is the state of subjective uncertainty. An individual encounters a novel object, which cannot be assimilated

mentally because the necessary cognitive schemata or categories do not exist. The discrepancy between the percept and the existing categories or schemata instigate a state of subjective uncertainty and interest in the object – curiosity (Schneider, 1987). This motivates the individual to explore the object. As a result of the exploration the individual learns the characteristics and functions of the stimulus. This learning about the stimulus removes subjective uncertainty (Schneider, 1987).

Similar to Berlyne's epistemic curiosity is Piaget's theory of curiosity. His theory is based on the disruption of cognitive equilibrium. The disruption of cognitive equilibrium begins by a conflict between incoming information and information already stored in long-term memory. The conflict produced by the discrepancy between these two sources of information motivates curiosity behavior. This behavior is used to help the individual find information that can be used to reduce the disequilibrium or conceptual conflict (Spielberger & Starr, 1994).

Nunnally and his associates have hypothesized that information conflict is the "most important factor in determining the amount of perceptual investigatory behavior" (Nunnally & Lemond, 1973). Information conflict tends to dominate other variables in governing visual investigation. Information conflict will elicit and maintain attention.

Curiosity and Learning

Understood information is both more readily retained and transferable than incompletely understood information. Learning motivated by curiosity can give rise not only to particularly rapid and lasting acquisition of knowledge but also to knowledge in which ideas are fruitfully pieced together into coherent structures (Neal, 1970).

Berlyne's (1954) work with high school subjects demonstrated that an increase in knowledge may result from an aroused high level of epistemic curiosity.

Messick (1979) suggested that high levels of curiosity can be induced by optimal levels of conceptual conflict and novelty, thereby affecting the learning process. Research by Inagaki (1978) did show that, regardless of verbal ability, the higher the curiosity demonstrated by individuals, the more measurable information they acquired.

The positive effect curiosity has on learning can be explained using the learning and memory model (Koran et al., 1984) (Figure 2-2). Curiosity is the response to a stimulus, which in turn functions to encourage students to use their senses to attend to the stimulus. The curiosity response can also act as a stimulus to influence attention, expand perception, and enhance encoding. After encoding occurs, information is registered in short-term memory. Some of the information will ultimately be stored in long-term memory. When retrieving information from long-term memory, there are more cues to provide linkages that can influence retrieval and response (Koran et al., 1984).

Curious children will stay in the vicinity of stimuli longer. As a result of these encounters, children focus on, and remember, particular characteristics of the objects or events. If curiosity is not evoked, there may be so little time spent in the vicinity of the object or event that the encounter will not make a lasting impression. Few characteristics or cues of the stimulus will be encoded and registered into long-term memory. The consequence is incomplete concept formation (Koran & Longino, 1982).

Highly curious children are more likely, on cognitive tasks, to outperform children displaying a lower degree of curiosity because they will explore objects and events with a greater number of their senses and for longer periods of time. The longer

time spent exploring a stimulus will allow for the encoding of more positive and negative cues. This should lead to a better understanding of what they are experiencing, better remembering, and facilitation of more complete concept learning (Koran & Longino, 1982).

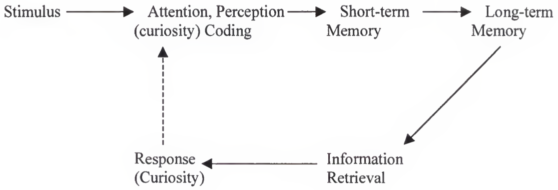

Figure 2-2. Learning and Memory Model (Koran et al., 1984)

In one part of a study in which children were asked to look at pictures and respond by asking questions about the pictures, Maw and Maw (1964, cited in Arnone & Small, 1995) found that high-curiosity children asked more questions and had more independent ideas than low-curiosity children. Highly curious children also acquire more information than low-curious children through exploration (Inagaki, 1978). Maw and Maw (1961) discovered that not only do highly curious children acquire more information, but they retain it better.

Henderson & Moore (1980) found high-curious children showed superiority over low-curiosity children on perceptual and problem solving measures. They asked more questions, performed more types of manipulations, and spent more time exploring. The

authors suggested that these differences demonstrated individual differences in exploratory styles and novelty preference. Arnone et al. (1994) found that high-curious children achieved significantly higher scores on an achievement test than low-curious children.

Individual Difference in Curiosity

The individual differences in novelty preference have been explained by Day (1982). Day believes there is an optimal level of arousal where an individual will enter a "zone of curiosity". If there is too much uncertainty (for example, a stimuli too high in a collative variable such as novelty), the individual will be overwhelmed or become anxious and enter "the zone of anxiety" (Arnone & Small, 1995). Too little stimulation results in disinterest or the "zone of relaxation. " This relationship is nonlinear (Figure 2-3). Individuals differ in their tolerance for novelty and where their "zone of curiosity" occurs. A stimulus that one finds optimally arousing may be overwhelming or understimulating to another. Individuals who have a higher tolerance for uncertainty will display higher levels of curiosity. They will not enter the "zone of anxiety" as quickly as a low-curious child will.

This "zone of curiosity" theory supports the observations that only stimuli that are novel and somewhat familiar arouse curiosity (Jones, 1979). Not all novel stimuli will elicit the curiosity response in an individual. Curiosity is aroused when an individual is partially familiar with a stimulus, not totally unfamiliar or completely familiar with a stimulus (Jenkins, 1969). It has been experimentally shown that children avoid the extremes of novelty, preferring an object that is neither too familiar nor too novel.

Children pick toys within a 25-75% novelty range (Vidler, 1977). If a stimulus is either too novel or familiar, curiosity will be inhibited and attention will wane (Vidler, 1977).

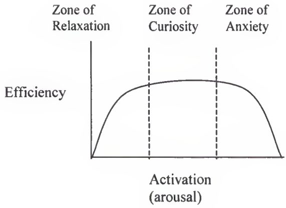

Figure 2-3. Zone of Curiosity (Day, 1982)

A series of studies conducted by Balling & Falk (1982) have documented the effects of varying levels of setting novelty on learning. Task learning and non-task behavior are inversely related. The level of setting novelty influences the occurrence of non-task behavior. The least amount of non-task behavior and the most amount of task learning occurred in the middle range of novelty. At the extremes, too familiar or unfamiliar, non-task behavior was great and learning was little (Balling & Falk, 1982).

Individual differences in curiosity can be expressed on more than just a high/low continuum. Individual differences in exploratory behavior can be due to differences in mode of response, in style of exploration, and in the elicitors of exploratory behavior (Henderson & Moore, 1979). Some individuals may express curiosity more through psychomotor means and others may use more verbal means. For example, some research has shown (Peterson & Lowery, 1972) that people who prefer to explore in a

psychomotor fashion explore less by verbal means and vise versa. Fire (1985) found that written curiosity did not predict psychomotor. Also, what an individual is curious about will vary from one person to another. Coie (1974) discovered that children who displayed high levels of curiosity in some situations failed to do so under other circumstances.

Individual differences in curiosity are fairly stable over time (Gold & Henderson, 1990; Libutti, 1978; Peterson, 1979). There are factors other than tolerance for arousal that may cause differences in the level of curiosity expressed by a child. For example, gifted children are reported to be more curious than average children of the same age (Gold & Henderson, 1990).

Using a "science at home" project and questionnaires, Shore (1996) concluded that well-educated, professional parents tend to create home environments that support scientific curiosity and nurture interest in science. Highly curious children tend to have parents who are supportive, attentive, and sensitive to their needs. Parents of highly curious children also are good models of curiosity behavior and reinforce their children for being curious (Johns & Endsley, 1977; Endsley, et al., 1979). At the other extreme, being an abused child may decrease a child's willingness to interact with novel materials Abused children also ask almost no questions when encountering novel stimuli (Bradbard et al., 1988). Being socially disadvantaged may also be a factor for low curiosity levels because socially disadvantaged youth live in unstimulating and dull environments (Singh & Sinha, 1990). Many of these factors can influence a child's curiosity response. While the cause of individual differences in the curiosity response is beyond the scope of the

current study, these factors offer further insight into why individuals may differ in their curiosity response.

Even though high-curiosity children may outperform low-curiosity children on cognitive tasks, high-curious children are not necessarily more intelligent. Theoretical reasoning would predict a strong positive relationship between curiosity and IQ. However, numerous studies have shown that there is no or little correlation between curiosity and IQ (Bradbard & Endsley, 1980; Gugula, 1980; Henderson & Wilson, 1991; Inagaki, 1978; Pielstick & Woodruff, 1964). Since high- curious children outperform low-curious children and curiosity is not correlated with IQ, curiosity level may be an important predictor for future learning ability. The ability to produce and work with new experiences in order to gain information is important (Henderson & Wilson, 1991).

Demographic Variables and Curiosity

Other variables that may play a role in the amount of curiosity observed are gender, age, and race. In general, the research on gender effects on children's curiosity is inconclusive (Maccoby & Jacklin, 1974). For instance, Schneider (1987) found that boys manipulate a novel object more frequently than girls and therefore boys appear to be more curious. Engelhard & Monsaas (1988) found no difference in school-related curiosity between genders. School-related curiosity was a measure of Maw and Maw's operational definition. Rabinowitz et al. (1975) found that boys spent more time exploring a novel toy but that there was no difference between boys and girls in the amount of information gained about the toy. Maw and Maw (1965) found that boys, significantly more often than girls, selected outgoing, investigatory activities. There have

been studies that show boys are more curious, girls are more curious, or no differences between the genders.

It is generally agreed that, overall, curiosity decreases with age. Engelhard & Monsaas (1988) found a significant decrease in school-related curiosity from third to seventh grades. Older average children show lower levels of curiosity than younger average children (Gold &Henderson, 1990). Shumakova (1992) used a picture task to measure question-asking as a form of curiosity. She found that for Russian and American children there was a decrease in the amount of question-asking as children got older. Curiosity increased until about 11 or 12 years old and then started decreasing (Shumakova, 1992). Subjects for the present study were from a close age range so that age differences did not influence the results.

Research suggests this decrease in curiosity may be due to teachers and other aspects of the school and classroom environment actively discouraging curiosity and other related behaviors (Engelhard & Monsaas, 1988). Engelhard (1985) reported that only 41% of fourth and fifth grade teachers encouraged curiosity whereas 65% of second and third grade teachers encouraged curiosity in the classroom. It has been suggested that the school environment is not conducive to curiosity, lacking the elements of novelty and surprise (Engelhard & Monsaas, 1988). Children often lose curiosity because of the emphasis on rote learning in school (Ramey-Gassert et al., 1994). A trip to the zoo, where there are many opportunities to encounter novel objects and events, may be the perfect experience for encouraging curiosity.

Peterson and Lowery (1972) found differences in curiosity behavior between African American and Caucasian children. African American children showed more

psychomotor curiosity than Caucasian children did. Shumakova (1992) found differences in the content of curiosity between Russian and American children as shown by the predominance of different question types. Catherwood (1988) found that Australian Aboriginal children and Caucasian children displayed similar levels and patterns of visual and tactile curiosity but Aboriginal children manipulated a novel object at a higher rate. Cultural factors may influence the type or amount of curiosity expressed through different means.

Curiosity Research Studies

Peterson & Lowery (1972) have investigated curiosity in a setting designed to be like a science center (Peterson 1979). The purpose of their original study (1972) was to compare the amounts of curiosity behavior expressed through motor activity among elementary-age school children that differed in age, sex, and racial/ethnic origin and to compare the results of that measure with another measure of curiosity, unsolicited questions. Curiosity was defined as coordinated sensory-motor responses directed toward the objects in a designated environment. “Motor activity associated with curiosity implies that information-gathering processes such as looking, smelling, tasting, listening, and touching were coordinated with movement of the body or parts of the body” (Peterson & Lowery, 1972, p. 194).

Peterson & Lowery (1972) found that the amount of curiosity expressed through motor activity did not decrease with age. They observed children between five and thirteen years old and found that curiosity expressed as motor activity was not significantly related to age. They did find that there were qualitative differences in the

motor activity. For example, instead of using the weights provided for use with the balance beam, the younger children used rocks from another station.

Peterson & Lowery (1972) also recorded the number of questions asked by students. They reported that kindergarten students asked more questions than other age groups. They also found that students who explored the most through motor activity explored least through verbal activity.

In a follow-up study, Peterson (1979) observed students from the original study six years later. She wanted to determine if there were changes in the expression of curiosity from childhood to adolescence. The students were now twelve to eighteen years old. She found that there was no decrease in the amount of motor curiosity expressed by the students. Overall, the amount of sensory motor curiosity was still high. The researcher speculated that the expression of sensory motor curiosity may be a matter of individual differences.

The results of the Peterson and Lowery studies (Peterson & Lowery, 1972; Peterson, 1979) are considered weakened due to their failure to control for threats to validity such as high drop-out rates (Ellis et al., 1991). In addition, even though the setting of the experiment was designed to be like a science center, it was still a lab room, and the experiment was not ecologically valid. Going to a museum or zoo is a dynamic experience. Researching the outcomes of such visits should be done in a naturalistic setting where the curiosity response can be observed (Ellis et al., 1991).

Koran et al. (1984) conducted a study in the Florida Museum of Natural History that also investigated psychomotor curiosity. In their study, museum visitors were given the opportunity to investigate an exhibit of uncommon seashells with varying degrees of

manipulation allowed. They found that as the age of the individuals increased, the less likely they were to touch the objects. Young children responded favorably to being able to explore the materials tactually.

Koran et al. (1984) believed that these findings "support the proposals of developmentalists that young children want and need a large amount of tactile interaction with their environments" and therefore express curiosity in a psychomotor manner (Koran et al., 1984 p. 233). They also provided an explanation for the observation of sensory-motor exploration decreasing with age. They state that an individual can also explore the environment through verbal, visual, and written means. Adults can gather information in ways other than psychomotor, so they express curiosity differently. When the shells were displayed without a cover, even though the adults did not manipulate them, they spent longer times observing them. They could visually explore the objects better at a close range (Koran et al., 1984).

Gottfried (1980) studied children's exploratory behavior in a science center/field trip context. He used the psychomotor scale to record exploratory behavior. His observations showed that students first engaged in diversive behavior as they explored their new environment. After a period of time, students then engaged in specific exploratory behavior with the exhibits. After gaining some sensory information about an animal in an exhibit, students conducted experiments according to exhibit instructions. Gottfried (1980) noted that there were individual differences in the depth of exploratory behavior at this stage for different students. Using a self-report questionnaire and "peer teaching," Gottfried (1980) concluded that students were learning in the science center.

Marsh (1978) conducted a study that examined the role of epistemic curiosity in a museum. Marsh investigated the level of epistemic curiosity expressed through question-asking during docent lead tours in an art museum. Questions were categorized into Type I and Type II. Type I questions were simple, exploratory questions concerned with facts and Type II questions were higher level, probing, "search for understanding" questions concerned with interpretations and meanings of the art. Type II questions were considered to represent more enhanced and expanded curiosity.

Pre-experimental results showed that visitors asked few questions and those that were asked were mostly Type I questions. Certain methods of conducting the docent tours increased the amount of question asking or epistemic behavior. The results indicated that during tours, docents need to ask Type II questions, and allow wait-time for answers and questions. Both of these methods increased the number of Type II questions or the amount of epistemic behavior. This study showed that epistemic curiosity can be encouraged in a informal setting.

In summary, curiosity is considered by theorists to be a prerequisite for learning. Curiosity impacts learning by influencing what an individual attends to. Attending to a stimulus is the first essential step in the Learning and Memory model. If a stimulus is not attended to or attended to for a short period of time, few characteristics or cues of the stimulus will be encoded and registered into long-term memory. The consequence is incomplete concept formation (Koran & Longino, 1982). High curious individuals are expected to perform better on cognitive tasks because of the increased attention and encoding. Curiosity can be used as an indicator of increased attention and should positively impact concept formation.

Little research has been done with respect to curiosity and learning past the preschool years (Rotto, 1994). Studies that have been done show positive correlations between curiosity and learning (Alberti & Witryol; 1994; Arnone et al, 1994; Inagaki, 1978; Paradowski; 1967; Vidler, 1977). However, there is little or no correlation between curiosity and IQ (Bradbard & Endsley, 1980; Gugula, 1980; Henderson & Wilson, 1991; Inagaki, 1978; Pielstick & Woodruff, 1964).

Curiosity is not a unitary construct and can be expressed in different ways. The most relevant to this study is specific curiosity. Specific curiosity is motivated by the need to reduce arousal and to find the information that will reduce conceptual conflict. Specific curiosity, therefore can be perceptual (psychomotor) or epistemic. Epistemic curiosity is the focus of this study.

Researchers have not found consistent results with respect to gender and curiosity. There have been more consistent findings with respect to age and curiosity. Overall, curiosity decreases with age. To negate any affects differences in age may have on the current research, a narrow age range will be used. Curiosity is not encouraged in the classroom of the targeted age range, fourth through fifth grades. It is believed that a novel environment such as a zoo will encourage curiosity.

Some researchers have examined curiosity in informal settings. Most of the research that has been done has focused on psychomotor curiosity. Marsh (1978) conducted a study to measure and increase epistemic curiosity in a controlled experiment using docent lead tours. The purpose of this research is to investigate specific epistemic curiosity before a visit to an informal setting. Using posttests, any change in epistemic curiosity caused by the experience will be documented.

Education in Zoos

The role zoos play in society has changed drastically through the years. "Historically, the main function of zoos was public recreation. The zoo was an 'animal park' where one could picnic surrounded by exotic animals" (Sanford, 1984, p. 36). Now most zoos have goals of conservation, research, entertainment, and education (Churchman, 1987). Education of the public has been established as the primary purpose of many of the American Zoological Association's registered zoos (Marshdoyle et al., 1982).

Even zoo visitors now realize the educational importance of zoos. Holzer et al. (1997) report that when surveyed, 92% of Americans agreed that animal parks educate people about animals they might not otherwise know about and 89% agreed that animals parks are important for educating children about animals.

Zoos have become the only place where the majority of people will have the opportunity to encounter animals and to learn about the problems they and their environments face. It is necessary for zoos to educate the generations who are growing up without any natural contact with wild creatures (Conway, 1969). The public has been removed from nature physically as well as psychologically. Urbanization has removed the public spatially and television has allowed a psychological detachment. Watching television is a passive experience; there is no contact or interaction with any of the subjects. A vicarious look is all that television permits (Zipko, 1974). The public receives a filtered experience based on the biases of the director. There is no opportunity for gaining knowledge through individual involvement. Zoos can therefore help to close the gap between humans and other species.

Conservation and communicating the importance of wild animals are the main goals of many zoo education programs (Dathe & Zwirner, 1974; Kinville, 1968; Blyth, 1971; Brereton, 1968). Since zoos worldwide have the ability to draw large numbers of visitors, they can have a significant impact on the general public's awareness and attitude toward conservation objectives (Keating, 1986). Zoos have unique opportunities to communicate conservation issues (Marcellini, 1976). They need to take advantage of these opportunities by fostering a conservation ethic in people who have no particular interest in nature, conservation, or the environment and inspire them to act to help solve some of the problems faced by those areas (Blakely, 1981). Education programs need to provide people with the concepts, skills, and attitudes needed to develop wiser behavior (Smyth, 1984).

Education of the public had becomes a priority for most American Zoo and Aquarium Association (AZA) zoos. However, according to Churchman (1985), the five factors that affect the educational impact of zoos that researchers have focused on are; 1) demographic information about visitors, 2) how zoos are utilized, 3) how visitors move through zoos, 4) the way visitors use their time at zoos, and 5) the social nature of visits. Educational impacts, in terms of a growth in knowledge, have not been well-studied (Braverman & Yates, 1989). Much of the literature that does exist is descriptive or is based on self-report tests.

Schnackenberg et al. (1997) conducted a survey to determine how much time visitors spent viewing the reptile section in a zoo, what the visitors did in the reptile section, and what visitors learned there. Visitors were posttested using a self-report interview technique to determine what they felt they had learned. Visitors were asked to

respond to the question "What are the main things you found out from viewing the reptile exhibit?." Based on visitors' responses, the authors concluded that visitors were learning from the exhibit.

Braverman & Yates (1989) used a pretest/posttest methodology that covered concepts and facts. Their research looked at the impacts of orientation sessions on knowledge gain. There was an increase in knowledge for all visitors to the zoo. Visitors who had the orientation session prior to a visit had a larger gain in knowledge than visitors without it. The limitation to the study was the subjects. They were participants in a 4-H club conference.

Marshdoyle, et al. (1982) have observed that children gain knowledge when they have been on a docent-led tour. The authors documented knowledge gain using pretest/posttests on facts and concepts. However, they reported that other studies have found no significant gain in knowledge on field trips. The authors did not investigate the causality of the student learning on the field trip and suggest further research to assess the educational value of school field trips.

Balling & Falk (1982) have done several studies on novel field trip environments. They found that fifth grade children who went to a novel setting learned best and that fifth grade children who went to a familiar setting showed the poorest performance on cognitive tasks. Behavioral data corroborated test scores. Third grade children were the opposite. Too little or too much novelty was counter-productive for their task learning. As explained by the Zone of Curiosity model (Figure 2-3), individuals have an optimal level of arousal. Preference for arousal can vary from occasion to occasion effecting the

way individuals perform in different settings (Arnone & Small, 1995; Balling & Falk, 1982).

Generalizing from their work, Balling & Falk (1982) conclude that fifth graders are ready for day field trips to institutions such as museums and zoos and that significant learning can occur on these trips. Younger children may not be as receptive. The zoo environment may be novel to students but older students should be capable of displaying specific curiosity not diversive curiosity. Specific curiosity will produce the learning outcomes that zoo educators are hoping for.

Wineman et al. (1996) have stated that " the needs of young children and teen-agers are not adequately being addressed, that these visitors are being inadequately served and less than maximally involved in conservation education" (Wineman et al. 1996, p.95). This growing concern among zoo educators regarding the education and participation of children and teenagers has raised questions about how to best serve these younger audiences. In order to address these audiences properly, their cognitive and affective needs must be determined to help provide guidance for the incorporation of appropriate materials into exhibits and programs. This study will provide valuable information to zoo educators by determining what children are curious about and what they are learning.

Thus, education has become a primary concern for zoos. Zoo educators are especially concerned about the younger visitors, which are currently being under-served. The literature on zoo education is inconclusive in regards to if and what visitors are learning in a zoo. There is some evidence that visitors are learning but the results were

mostly based on self-report tests. A more systematic investigation of what visitors are learning is needed.

This study will be an important addition to the literature by documenting the educational value of a zoo by investigating learning outcomes. Also, the novel stimuli, the exhibits and animals, may evoke curiosity, which may be the cause of subjects' learning. This study will investigate curiosity's role in learning from a zoo field trip. Research has also shown that some age groups are more ready than others to learn from novel environments (Balling & Falk, 1982). Fifth grade students are ready to learn on field trips to the zoo. Fifth and fourth grades will be the targeted age group for the current study.

Attitudes

"Zoos are now being challenged to elicit an affective response from visitors. By involving not only the minds but the hearts of the public, zoos hope that the visitors will be moved toward positive actions on behalf of the environment after their zoo visits" (Berkovitz, 1988). Awareness in zoo visitors must be developed so they know their efforts can contribute to the preservation of a species in its natural habitat (Birney & Shaha, 1982).

Many zoo educators feel the need to produce a lasting positive attitude in their visitors that may in turn lead to a beneficial behavior for wildlife. Since attitude does play an important role in regulating one's overt behavior, zoos will need to mold new attitudes to develop the desired behaviors (Rajecki, 1982).

The appearance of an attitude is considered to be dependent on learning and once an attitude is formed it is relatively enduring. Therefore, what a person originally learns is likely to form a lasting attitude in relation to a particular object (Sherif & Sherif, 1967). However, emotionally toned dispositions (attitudes) may be established or changed as a consequence of experience, instruction, or communication (Rajecki, 1982). By increasing the amount of knowledge of (or awareness) or experience with animals and nature, zoos may be able to mold attitudes and hence bring forth the behaviors the educators desire.

Attitudes or the beliefs attitudes are based on are comprised of three components: affect, behavior, and cognition (Ronkeach, 1970; Rajecki, 1982). The components of attitude are at least intuitively related and a change in one will influence the others. If cognition about an object changes, affect for the object should be revised accordingly (Rajecki, 1982). Manipulation of a subject's cognition is likely to be accompanied by a change in affect. If a consistency develops between cognition and affect then behavior is somewhat predictable (Rajecki, 1982). By increasing the public's knowledge about and affective response toward animals, zoos may be able to alter the public's behavior when it comes to conservation and environmental issues.

Attitudes may be formed or molded based on direct experience with an object. Future behaviors may be predicted from these attitudes. Direct experiences may form attitudes in one of two ways. First, the experience may simply make more information about the object available which may result in a more accurate attitude, or the experience may lead to repetition and rehearsal which may make the attitude more readily and accurately retrieved from memory (Rajecki, 1982). Since attitudes will not change in one

visit, zoos must start with the basics: cognition and affect. If an individual is made more knowledgeable about a subject and also develops a more positive affective response, the individual is likely to develop a more positive attitude for the subject.

One study found that knowledge, per se, played a relatively small role in predicting high school and undergraduate students' attitudes towards wildlife (Adams et al., 1986). The more important factor in this case may be the affective response. Therefore, zoos should not only try to increase the visitors' knowledge about wildlife but should try to change the visitors' affective response.

Kidd et al. (1995) report that there are very few studies that examine the effectiveness of any programs designed to change visitor's attitudes. According to the authors, there are few studies of the cognitive and emotional aspects of attitudes toward and knowledge about wildlife among older age groups.

The authors conducted a study using observations of young children to the main zoo and the petting zoo. They concluded that petting zoos and hands-on experiences with animals, skins, etc. would improve attitudes. However, they did not measure any attitudes; their conclusions were all based on observations (Kidd et al., 1995).

Some studies have shown that exposing subjects to live animals and especially letting them have contact with them creates positive changes in attitude (Bevins & Bitgood, 1989; Kress, 1975; Sherwood et al., 1988). Although these studies were not conducted in a zoo, they do show that it is possible to change attitudes toward animals. One study went further and investigated behavioral changes. The animals in consideration were snakes. After exposure, subjects had better attitudes but their

behavioral tendencies did not change. Repeated exposure, not single experiences, may be necessary to change behavior (Bevins & Bitgood, 1989).

In a national study of attitudes about wildlife, it was found that children in the South had the most negativistic attitudes. This attitude is one of fear and avoidance. Also, urban children are the most fearful and girls were much more afraid of animals than boys (Westervelt & Llewellyn, 1985). However, a study in Canada found that males and females had very similar attitudes toward wildlife (Eagles & Muffitt, 1990). Other attitude differences found between the sexes are that females have a more humane orientation to animals and males are more likely to have a detached and pragmatic view (Birney & Heinrich, 1991).

Children that live in the south, and females in general, were also the least knowledgeable about wildlife. Knowledge about and fear towards animals were negatively correlated, suggesting a relationship between the amount of knowledge an individual had and their attitude (Westervelt & Llewellyn, 1985). Kellert (1985) found that African Americans and urban children were the least knowledgeable about wildlife. Rural students, on the other hand, were quite knowledgeable about wildlife. However, children overall had little knowledge about endangered species. In contrast, Stoneburg (1981) reports that urban students outperformed rural students on knowledge and had more positive attitudes. The area an individual lives in, race, and gender may each have an impact on attitude and knowledge about wildlife.

One indicator of affect toward an object is whether individuals like or dislike the object or how positive or negative they feel towards the object (Mueller, 1986). Several studies have looked at preference for different types of wildlife (Bart, 1972; Collins,

1976; Morris, 1960; Surinova, 1971; Westervelt & Llewellyn, 1985). The results consistently show that mammals and large animals are favored among children and young adults. Birds are also liked. Animals that are unpopular are predators, small animals, and cold-blooded animals (snakes). Animals that were liked and disliked were found to be consistent in different areas of the U.S (Collins, 1976). However, Surinova (1971) found that among three studies, the animals disliked were similar but there were ethnic differences (Czech and British) on animals that were liked. For instance, Britains tended to like foreign animals such as elephants and giraffes and Czechs liked more familiar animals such as deer and cats. Both disliked animals such as snakes and rats.

Consistency in reports of animals disliked show that many people, from children to young adults have negative perceptions of certain animals. Since most of these studies were done with adults, more documentation of children's perceptions is needed. The current study will document animals that children report to like and dislike as an indicator of their attitude towards certain groups of animals, and whether the trip to the zoo has any influence on these choices. Also, some research has shown that gender and race may have an effect on children's attitudes toward and knowledge about wildlife. Therefore, gender and race will be investigated as variables that may impact whether or not an individual likes certain types of animals.

It is important for wildlife and zoo professionals to have an understanding of the preferences and attitudes of the public. The wildlife orientation of the public can effect how wildlife, especially endangered species, and their habitat get managed (Westervelt & Llewellyn, 1985). Negative perceptions can foster negative consequences for the environment and wildlife (Adams et al., 1986). This is due to the dependency of wildlife

management policies on the demands the public makes on environmental and wildlife resources and "the societal attitudes that underlie a political response" (Eagles & Muffitt, 1990 p. 41). Attitudes play an important role in regulating one's overt behavior and therefore, how individuals use wildlife and whether or not they will support conservation (Rajecki, 1982). The zoo's role is to understand and influence perceptions and attitudes.

Prior Knowledge

Aptitude-treatment interaction (ATI) research investigates how individual differences modify treatment effects. An aptitude-treatment interaction is present when one instructional treatment is significantly better for one type of student while an alternative treatment is significantly better for a different type of student (Koran & Koran, 1984).

An aptitude is any characteristic of a person (cognitive, psychomotor, affective) that functions to either facilitate or interfere with learning from some designated instructional material (Koran et al., 1989). A treatment is any type of instructional method to which a learner is exposed with variations in structure, pacing, style, modality, instructor, or learning setting (Cronbach & Snow, 1977).

The search for ATI is based on the premise that there is no one best educational treatment or environment suited to some general average individual but that different individuals thrive in different environments suited to their own characteristics and needs. The general objective of ATI research is to match instructional methods or materials to selected learner characteristics (Koran & Koran, 1984).

There has been no extensive search for ATI or individual differences in informal settings. One possible consideration is that the zoo environment is an optimal place for high-curious but not low-curious students to learn. Kempa & Diaz (1990) found that students who were motivated by curiosity do not like formal learning and prefer discovery learning situations. Curiosity motivated learners want to be actively involved in learning activities that require them to discover and seek information. They do not want to be receptors of information or play the role of passive learner. They prefer open-ended learning tasks (Kempa & Diaz, 1990). Currently, the Lowery Park Zoo does not have any formal activities for school groups to do while they are in the zoo. Generally, teachers come to the zoo and explore without any structured activities. These types of visits may benefit the high-curious student since learning is taking place in open-ended and discovery situations.

In addition, there are some individual-difference variables that consistently correlate with learning and also tend to give relatively consistent ATI results. One of these variables is prior knowledge (Koran & Koran, 1984). Investigators of variable effects indicate that prior knowledge explains between 30 to 60 percent of the variance in posttest scores and that prior knowledge overrules all other variables (Dochy, 1990).

Existing knowledge at the onset of instruction plays a very important role in learning from instruction. A substantial part of ones' existing knowledge has been acquired during prior instruction. Since learning builds on learning, it is necessary to assess prior knowledge before a learner proceeds to the next learning task (DeKlerk, 1987).

For the purposes of empirical research, prior knowledge is defined as the whole of a person's actual knowledge that: (a) is available before a certain learning task, (b) is structured in schemata, (c) is declarative and procedural, (d) is partly explicit and partly tacit, (e) contains content knowledge and metacognitive knowledge, and (f) is dynamic in nature and stored in prior knowledge base (Dochy, 1990).

Schemata are defined as highly organized structures that store conceptualizations, objects, events, and actions, as well as sequence of these phenomena. They are assumed to be formed by observing multiple examples of a category, such that an abstract or generic form of the category comes into existence (Rembold & Yussen, 1986).

Schemata are believed to simplify the storage of concepts as well as to guide the acquisition of new information. Schemata are the reason why prior knowledge is important; knowledge allows a particular schema to be instantiated, or called up from memory, and hence allow related material to be learned. New information is believed to be learned via its connection to previously acquired, related material (Rembold & Yussen, 1986).

The activation of existing cognitive structures generally exerts a facilitating influence on the learning task. Prior knowledge is said to influence each of these phases: the direction of attention, the encoding of information, its processing in working memory, storage in long-term memory, and retrieval of information from long-term memory (Dochy, 1990).

During an informal learning experience individuals seek relationships between their own knowledge/experience and the content/structure of the exhibit. Visitors will interpret exhibitions using their own background experience, knowledge, and interests.

In order to enable concept acquisition, educators must go beyond just presenting information and take into account what learners are bringing to the learning situation (Milan, 1995).

Prior knowledge should always be contemplated when designing a study because in previous research done in formal learning situations it has been shown to be an important factor. "Perhaps the single most important factor that will determine what a learner takes away from an informal science experience is what she/he comes with" (Koran & Schafer, 1982, p. 60). Student's prior knowledge of the material being covered in this study may influence the results. The student's prior knowledge should be taken into consideration to determine if it is facilitating learning and if different amounts of prior knowledge influences the amount of curiosity expressed by the students. One way an individual may gain prior knowledge of an informal setting is previous trips to the institution. As part of this study, differences in prior knowledge and experience were also investigated based on whether the students had been to the zoo before.

Summary

The above literature review substantiates the need for the present research. Currently, there is scarcity of data to substantiate that trips to the zoo have a positive effect on learning. The current research assessed the extent to which subjects learned on a trip to the zoo.

Curiosity data is lacking for informal learning environments. One purpose of the present study will be to determine how curious students are about the zoo before they go on the trip and then determine if the trip has any effect on the curiosity level. It has been shown that more data on curiosity and learning is needed, especially in informal learning

environments. This study will determine the impact of curiosity on the learning that occurs during a trip to an informal setting.

In addition to investigating the role of curiosity in a zoo, the current study will examine the role different student characteristics have on both curiosity and learning. Student characteristics that may have an influence on curiosity are gender, race, and prior knowledge. Also, prior knowledge is an important variable to consider because it influences how an individual interprets and remembers new information and consequently what they learn. One factor that may influence students' prior knowledge and also curiosity is whether or not they have visited the zoo before. Students will be asked to report if they have been to the zoo before and prior visitation will be investigated as a factor that may influence prior knowledge and curiosity.

Since zoos are increasingly concerned with changing visitors' affective response, an important variable to explore is what animals do students like and dislike. As part of this study, students will be asked to report what animals at the zoo they like and dislike and why they feel this way. A critical part of this analysis will be examining any change in these responses caused by the field trip.

Hypotheses

Based on the aforementioned research, the following hypotheses were formulated:

1. There is no significant difference between the pretest and posttest curiosity measures.
2. There is no significant difference in students' curiosity based on race, gender, prior knowledge, or prior visitation to the zoo.
3. There is no significant difference between the pretest and posttest cognitive measures.

4. There is no significant difference in performance on the cognitive measure based on level of curiosity.
5. There is no significant difference in performance on the cognitive posttest based on race, gender, prior knowledge, or prior visitation to the zoo.
6. There is no significant difference between students' pretest and posttest preference for animal types.
7. There is no relationship between prior knowledge and previous visitation to the zoo.

CHAPTER 3
METHODOLOGY

Study Site

This study was conducted in conjunction with the Lowry Park Zoological Garden in Tampa, Florida. The zoo is considered a mid-size zoo. It has an annual attendance of 600,000 visitors and between 80,000 – 90,000 of these visitors are children in school groups. The majority of the school groups come for "self-guided" tours in which the teachers and the chaperones are responsible for the content of the visit. The groups explore the zoo on their own and in accordance with individual teachers' agendas. The majority of the groups arrives between 9:30 a.m. and 10:00 a.m. and finishes the visit around lunchtime.

The exhibits in the zoo are arranged on circular trails and each trail is based on a theme. The zoo had trails based on the following themes: Florida wildlife, Asian wildlife, and primates. The zoo also includes a free flight aviary and a petting zoo area. The Lowery Park Zoo has a wide variety of animals but does not include some of the animals traditionally found in zoos such as lions, elephants, zebras, and giraffes.

Participants

The study participants were fourth through fifth grade students from Robinson Challenge Elementary School in Clearwater, FL. Since research has shown that curiosity

changes with the age of the subjects and age is not a variable of interest to the current study, participants from a very small age range were used. Robinson Challenge school was chosen from the schools going on trips to the zoo because they were bringing children from the desired age range.

After contact with the school and arrangements had been made to participate in the study, the researcher found out that the Robinson Challenge School only contains fourth and fifth grade classes. The school only has fourth and fifth grade classes because it is not an ordinary elementary school but is a dropout prevention program. The academic portion of the schooling is the same as other schools but these children are given additional help with their academics, have smaller classes than in the normal public schools, and participate in programs to develop better social skills and coping mechanisms. The children that attend this school have been identified as children that have potential but are at-risk for dropping out of school. Factors used as identifiers for being at-risk include poor family life and low Socioeconomic Status (SES).

The school has ten classes, five are fourth grade and five are fifth grade. There are 182 students in the school. All students were given permission slips and asked to participate in the study. One class did not participate in the study because the teacher was absent the day of data collection and her students were disbursed among the rest of the classes. There was no consistent access to the students or the permission slips for them. After losses due to absences, students not completing one or more of the tests, or failure to return a permission slip, there were ninety-six participants.

Independent Variables

The following characteristics of the students were independent variables for the study: gender, race, prior knowledge, curiosity, and prior visitation to the zoo. Gender and race were obtained from school records. Prior knowledge was the students' scores on the cognitive pretest. Curiosity was determined using a paper and pencil Likert-type test. Students answered a question about prior visitation on the affective instrument.

Gender

There were more males than females present in the school and in the study sample. However, the percent of males and females in the study sample was representative of the school population (Table 3-1). The school population is composed of 113 males and 69 females. The study sample was composed of 58 males and 37 females. Gender was a categorical independent variable.

Table 3-1. Gender percentages for the school population and study sample

	Male	Female
School	62%	38%
Study	60%	40%

Race

The school population included 46 African American, 6 Hispanic, 1 Asian, 1 mixed race, and 128 Caucasian students. The study sample was comprised of 25 African American, 2 Hispanic, 1 Asian, 1 mixed race, and 67 Caucasian students. Again, the study sample was representative of the school population (Table 3-2). Since the percentages of Asian and mixed race students were so small, one student in each

category, these participants were not used for the data analysis. Race was a categorical independent variable.

Table 3-2. Race percentages for the school population and study sample

	Hispanic	African American	Asian	Mixed Race	Caucasian
School	2.0%	26.0%	1.00%	1.00%	70%
Study	3.3%	25.3%	.56%	.56%	70.3%

Prior Knowledge

Students' score on the cognitive pretest was used as an indicator of their prior knowledge. The students' scores were based on the number of concepts the students reported on the measure. Prior knowledge was an interval independent variable. The discussion on the cognitive instrument describes in more detail how the test was scored.

Curiosity

Students' scores on the curiosity posttest were used for this independent variable. Students' scores on the test ranged from one to five, with one being low curious and five being highly curious. Curiosity was an interval independent variable.

Prior Visitation

Students were asked to indicate whether their field trip to the zoo was their first visit or whether they had visited the zoo before. Prior visitation was a categorical independent variable with students designated as first-time or repeat visitors. Out of 96 participants, 85 reported whether they had been to the zoo previously. Only 27 or 28.1%,

of the participants were first-time visitors. Fifty-eight or 68.2% had been to the zoo previously and 11, 11.5% did not respond to the question.

Dependent Variables

The dependent variables for this study were performance on the pretest curiosity measure and the posttest cognitive measure. Both of these measures were scored on an interval scale. The curiosity score was based on a Likert-type scale and ranged from one to five with one being the least curious and five being the most curious. The cognitive score was based on the number of concepts reported by the participants.

Study Design

The design of this research was pretest/posttest design without random selection. Since the researcher used a group already planning on visiting the zoo, random selection from the population was not possible.

A control group was not used in this study for two reasons. First, the studies' participants were unique because of the school program they were in. It was not possible to find another sample of students similar enough to use as a control group. Using any other sample of students would have made the study a comparison of the two types of students not a treatment/control group. Second, a pilot study conducted prior to this research demonstrated that the students performed the same on the pretest and the posttest. The students did not become "testwise" and perform better on the posttest as a consequence of taking the pretest. Therefore, it was believed that the study could be conducted without a control group.

The design for the study looks like the following:

O X O

Where O = the pretest/posttest and X is the treatment, a visit to the zoo.

General Procedures

A school scheduled to visit the Lowry Park Zoo was selected from the zoo's group tour lists. The researcher contacted the teacher who organized the field trip. The researcher explained the scope of the proposed study and asked the teacher to discuss participation in the study with the other teachers and the principal. Subsequently, a meeting with the researcher, teachers, and the principal of the school was held to discuss the study. The teachers and the principal agreed to participate in the study and signed informed consent releases.

Informed consent releases for the children were distributed to the teachers. Each teacher gave the informed consent releases to their students. The informed consent releases were taken home to the parents to be read and signed, permitting their children to participate in the study and for the researcher to obtain student information from school records (Appendix A). The teachers then collected the releases and gave them to the researcher on the day of data collection. Participants in the study were all children who brought back signed informed consent releases.

The researcher went to each class during the two days before the field trip and administered the tests. Before passing out the tests, the researcher read a verbal assent script to the students. Anyone who did not want to participate in the study could tell the researcher at that time. None of the students requested to be removed from the study.

Participants who brought back the informed consent releases were given the tests while the other students did quiet activities (reading, drawing) at their desks.

Participants were given the cognitive task, affective measure, and curiosity measure. Participants were given as much time as was needed to complete the task. The students went on the field trip to the zoo with their classes. The teachers were directed to conduct the trip and any pre/post trip activities the way they had planned before becoming part of the study. During the two days immediately following the trip, the researcher went back to the classrooms and administered the same tests.

In addition, the teachers were asked to fill out a questionnaire describing what types of trip activities they did with their students. All of the teachers, except one, did a pretrip activity. These activities included watching videos, discussing the animals they would see at the zoo, discussing the field trips in general, and reviewing zoo rules. Only one teacher did a during-trip activity, which consisted of making observations of birds and mammals. Only one teacher did a posttrip activity before the posttest. The posttrip activity consisted of a trivia and word search game. A multiple regression analysis was conducted to see if there was a class affect on performance on the posttest cognitive score. There were no significant differences between classes ($\alpha = .05$).

Instrumentation

Curiosity

Knowledge of different factors that effect visitor learning will allow for better preparation of exhibits and experiences so that all visitors can more effectively learn in informal settings such as zoos (Thomson & Diem, 1994). Curiosity about the zoo and its

animals before the trip may influence what and how much students learn during their field trip. A type of curiosity that can be measured before the trip is specific epistemic curiosity.

Epistemic curiosity will be measured using a self-report scale as a pretest/posttest (Appendix B). The scale was adapted from a test developed by Leherissey (1971). The original scale was designed to measure epistemic curiosity and could be applied to different learning situations. The Leherissey scale has an alpha coefficient of .89. To establish the validity of the test, procedures such as examining the correlation with a trait curiosity scale were conducted. The scale was adapted to measure epistemic curiosity for zoo animals. Differences between pretest and posttest scores were used to provide a measure of the zoo visit's impact on curiosity.

The activity description was the following:

> Listed below are sentences people use to describe themselves. Read each sentence. Then on a scale from 1 – 5, with 1 being not at all and 5 being very much, circle the answer your think best describes how you would feel while learning about new zoo animals.

Since some participants did not provide responses for all 18 statements, the sum of all the statement scores could not be used as the participant's score. Therefore, the average of the participant's answers was used as the curiosity score. A participant's score on the curiosity test ranged from one to five.

Cognitive

Cognitive gain was assessed using a method similar to personal meaning mapping (PMM) (Falk et al., 1998) (Appendix C). This method was used for the study because it provides a broad perspective of what subjects are learning about and experiencing at the zoo. There were no specific learning objectives for the study that could define specific facts or concepts to test for. The objective of the study was to determine what students were learning overall from the experience.

This method takes into consideration that individuals bring with them a unique knowledge base and what is subsequently learned is unique. "PMM does not assume that all learners enter with comparable knowledge and experience, nor does it require an individual to produce the 'right' answer in order to demonstrate learning. PMM is designed to measure how a specified 'educational' experience uniquely affects each individual's personal conceptual, attitudinal, and emotional understanding" (Falk et al., 1998, p.109). What exactly visitors learn will vary, the degree of change is what is comparable among individuals (Falk et al., 1998).

According to Falk et al. (1998), PMMs measure learning by assessing change from pretest to posttest across four semi-independent dimensions. Therefore, the same instrument was used as the pretest and the posttest. PPMs can be used to assess 1) the extent of an individual's knowledge and feelings, 2) the breadth of an individual's understanding, 3) the depth of understanding, and 4) mastery.

The two categories that were used to measure cognitive gain for this study are the extent of an individual's knowledge and the breadth of an individual's understanding. The extent of an individual's knowledge or the change in quantity of appropriate

vocabulary used is determined by comparing the number of relevant words/phrases used on the two tests (Falk et al., 1998). The breadth of understanding or the change in the quantity of appropriate concepts used is determined by classifying responses into conceptual categories and then comparing the number of these categories on the two tests (Falk et al., 1998).

The cognitive test used for the current research was similar to the PMM in that it asked participants to write down anything they thought of while thinking about the selected topic, in this case, a zoo. However, it is different than the PMM because the researcher chose not to use interviews. The original PMM was designed to use interviews to probe visitors' responses. For this study, the researcher was only interested in what the participants could think of without being probed. Also, since the participants were children, the researcher was concerned with adding bias to the answers by possibly leading the participants' responses.

The PMM is similar to the instrument that has been advocated in science classrooms under the name concept mapping (Novak & Gowin, 1991). The difference being that PMMs are less structured than concept maps. Therefore, they do not require the training necessary to be used correctly, allowing their use in informal settings.

Guidelines were developed for categorizing participants' responses for the cognitive measure. Using content analysis, any responses that were about animals were categorized by scientific classification (i.e. kingdom, class, order, family, genus, and species). Other concepts were divided into relevant categories. Some of the other categories had titles such as affective terms, people, natural features, and man-made features.

Inter-rater reliability was determined amongst the researcher and two other raters who had scientific backgrounds. Five tests were randomly selected from the 96 pretests as a practice session for the raters. The guidelines were explained, any questions about the procedures were discussed, and then the tests were rated. During the practice session it became apparent that more clearly defined guidelines needed to be determined for rating the animals. Using a biology text, the raters more clearly categorized the animal names used by participants into the scientific classification scheme. Ten more tests were selected for the actual inter-rater reliability. The inter-rater reliability was .86. The researcher analyzed the rest of the tests.

Affective

The affective measure was designed to be very simple and straightforward (Appendix D). Participants were asked to write down what was their favorite and least favorite animal at the zoo and why. On the affective measure the participants were also asked to report whether or not they had been to the Lowery Park Zoo before.

Content analysis was used to categorize responses from the affective questions. Two sets of categories were created. The first set of categories was created based on past research in this area. Responses were categorized into the types of animals that the participants reported to like or dislike. Examples of categories are primates or birds.

The second type of category was based on the reasons the participants gave for liking or disliking the animals. The responses were divided into categories such as physical characteristics (ex. run fast, strong) or affective attributes (ex. cute). For both sets of categories, frequencies of responses were used in the data analysis.

Data Analysis

Since multiple regression analysis can be used for both interval and categorical data, it was used to determine the relationships between the independent and dependent variables. Multiple regression provides an estimate of magnitude and statistical significance of the relationship among the variables (Shavelson, 1988). The independent variables that are the best predictors for the dependent variable can be identified.

The regression models to analyze the hypotheses were:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4 X_4$

Where Y = curiosity

X_1 = prior knowledge X_3 = race

X_2 = gender X_4 = prior visitation to the zoo

and

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$

Where Y = cognitive gain

X_1 = curiosity X_4 = race

X_2 = prior knowledge X_5 = prior visitation to the zoo

X_3 = gender

In addition, dependent t-tests were used to determine if there was any change from pretest to posttest for curiosity or the cognitive measure. Dependent t-tests were also used to determine if there was a change from pretest to posttest in the types of concepts reported. Since all of the data for the affective measure was categorical and

based on frequency, Chi-squares were used to determine differences between the pre and post trip data.

Pilot Study

A pilot study was conducted to determine the test-retest and internal consistency reliability of the instruments that were used for the research. The pilot study was also used to determine if taking the pretests had any effect on posttest answers. The pilot study was conducted at the University of Florida's developmental school, P.K. Yonge. The testing was done with fourth and fifth grade students, the target age range for the current research.

The cognitive measure had a test-retest reliability of .708 for the number of concepts and a test-retest reliability of .70 for the number of categories. Considering the cognitive test was open-ended, this is an acceptable reliability score. The test-retest reliability was .859 for the curiosity scale. The internal consistency of the original curiosity scale was .87. Further analysis showed that several of the questions were not contributing to the internal consistency. Two of these questions were changed and two of the questions were dropped from the final version. The internal consistency of the 18-question test was .893.

Hypotheses

In the present study, the following hypotheses were tested:

1. There is no significant difference between the pretest and posttest curiosity measures.

2. There is no significant difference in students' curiosity based on race, gender, prior knowledge, or prior visitation to the zoo.
3. There is no significant difference between the pretest and posttest cognitive measures.
4. There is no significant difference in performance on the cognitive measure based on level of curiosity.
5. There is no significant difference in performance on the cognitive posttest based on race, gender, prior knowledge, or prior visitation to the zoo.
6. There is no significant difference between students' pretest and posttest preference for animal types.
7. There is no relationship between prior knowledge and previous visitation to the zoo.

CHAPTER 4
RESULTS

Curiosity

To determine curiosity, participants were asked to rate statements about zoo animals on a scale from one to five, with one being "not at all" and five being "very much" (Appendix B). Participants' mean scores could range from one to five. A participant's response of one would indicate a low curiosity level. A participant's response of five would indicate a high curiosity level. The hypotheses relevant to curiosity are Hypothesis 1 and Hypothesis 2.

Hypothesis 1

To test Hypothesis 1: there is no significant difference between the pretest and posttest curiosity measures, a dependent T-test was used. Descriptive statistics for the pretest and posttest are reported in Table 4-1. Participants ranged from being low curious, 1.29, to high curious, 5, on the pretest and low curious, 1.2, to high curious, 5, on the posttest. The mean for both the pretest, 3.92, and the posttest, 3.77, showed that, overall, participants were curious about zoo animals. However, participants' curiosity was unaffected by the visit to the zoo. The T-test showed that the difference between the pretest and posttest means was not significant ($T = -1.795$, $\alpha = .05$). The null hypothesis was not rejected for Hypothesis 1.

Table 4-1. Descriptive statistics for the curiosity measures

Variable	Mean	Std Deviation	Range
Pretest Curiosity	3.92	.88	1.29 - 5
Posttest Curiosity	3.77	.88	1.20 - 5

Hypothesis 2

A multiple regression analysis was used to test Hypothesis 2: there is no significant difference in students' curiosity based on race, gender, prior knowledge, or prior visitation. Multiple regression analysis examines the relationship between the dependent variable, curiosity, and the independent variables, race, gender, prior knowledge, and prior visitation to the zoo. The summary table (4-2) shows that there were no significant differences in posttest curiosity based on race, gender, prior knowledge, or prior visitation to the zoo. None of the independent variables examined influenced the students' curiosity level. This was also true for pretest curiosity levels. Hypothesis 2 was not rejected.

Table 4-2. Summary of regression analysis for predicting curiosity

Parameter	Estimate	Standard Error of Estimate	T for HO: Parameter = 0	Pr> | T |
Intercept	3.728874303	.24483886	15.23	0.0001
Preconcept	0.015178521	.01255510	1.21	0.2303
Gender 1	-0.226617539	.19327541	-1.17	0.2446
2	0.000000000	-	-	-
Race 2	-0.251468930	.22012429	-1.14	0.2568
3	-0.340297043	.62769192	-0.54	0.5893
4	0.000000000	-	-	-
Trip 0	0.257266385	.20838861	1.23	0.2207
1	0.000000000	-	-	-

Cognition

Participants were asked to think about going on a trip to the zoo and were instructed to write down all the words they thought of that were related to the zoo. With these directions, each participant produced a list of concepts. The total number of relevant concepts produced by each participant was used as the cognitive-concept score. The pretest cognitive-concept score was considered the prior knowledge score. These concepts were then categorized into groups based on similarity. The number of groups that the concepts fell into was a participants cognitive-category score. The hypotheses relevant to cognition are Hypothesis 3, Hypothesis 4, and Hypothesis 5.

Hypothesis 3

To determine if the field trip was producing any changes in the participants' cognition, a dependent T-test was used to test hypothesis 3: there is no significant difference between the pretest and posttest cognitive measures. The descriptive statistics for the test can be found in Table 4-3.

Table 4-3. Descriptive statistics for the cognitive measure

Variable	Mean	Std Deviation	Range
Pretest - Concepts	11.23	7.7	0 - 33
Posttest - Concepts	12.21	10	0 – 53
Pretest - Categories	5	2.56	0 – 12
Posttest- Categories	5	2.53	0 - 13

There were two parts to the cognitive measure, the number of relevant concepts and the number of categories of these concepts. There was a slight increase in the number of concepts given by the participants. On the pretest, participants could think of

11.23 concepts when thinking about a trip to the zoo. On the posttest, this number increased to 12.21. However, this difference was not significant ($T = 1.28$, $\alpha = .05$). There was a very large range in the number of concepts identified by participants. Some participants spent a considerable amount of time and thought on the responses and reported up to 53 concepts. Other students turned in their papers with no concepts or only 1 concept. There was no difference in the number of categories. On average, participants' concepts could be categorized into five groups on both the pretest and the posttest. Hypothesis 3 was not rejected.

While there were no significant differences in the total number of concepts reported on the pretest and posttest, there were some significant differences in the types of concepts reported. A content analysis was conducted on the participants' responses (type of animals), and the concepts were organized into categories. Numbers reported here correspond to number of responses because each animal was mentioned by multiple participants and each participant reported multiple animals.

The first category was based on the presence or absence of the animals in the zoo. On the pretest, 386 or 63.2%, of participants' responses identified animals that the Lowery Park Zoo displays. However, 225 or 36.8% of participant responses also identified animals that the Lowery Park Zoo does not display. On the posttest, these numbers changed dramatically. On the posttest, 618 or 81.5%, of participants' responses correctly identified animals that the Lowery Park Zoo displays and only 140 or 18.5% of participant responses identified animals that the zoo does not display. Table 4-4 provides a summary of these results. A more detailed analysis of the animals identified follows in the discussion on the zoo experience.

Table 4.4 Summary of participant responses that correctly and incorrectly identified Lowery Park Zoo animals

	Present in Zoo		Absent from Zoo	
	#	%	#	%
Pretest	386	63.2	225	36.8
Posttest	618	81.5	140	18.5

Using dependent t-tests, it was determined that these differences were significant ($\alpha = .05$). The pretest mean for the number of animals identified in the zoo was 4.43 and on the posttest this number increased to 7.2. The mean for the number of animals identified that were not in the zoo decreased from 2.96 to 1.68. T-tests also showed that within the pretest and the posttest, participants were more likely to identify animals that were displayed by the zoo than animals that were not. However, the difference between the means was much greater for the posttest. On the pretest the means were 4.43 and 2.96 for displayed and not displayed, respectively. The means changed to 7.2 for animals displayed by the zoo to 1.69 for animals not displayed by the zoo.

The second category for participants' responses was based on the classification level of the animals. On the pretest, 148 participant responses or 24.2% identified animals by species name. On the posttest this number increased to 243 or 31.3%. Overall, participants identified more animals by species name on the posttest than on the pretest. A dependent t-test showed that these differences were significant ($\alpha = .05$). The mean increased from 2.05 to 2.85. Examining these numbers more closely, the number of responses on the pretest and posttest that identified species not displayed by the zoo were the same, 77 and 78 respectively. That means more of the responses on the posttest correctly identified animals displayed by the zoo. On the pretest, only 71 responses,

11.6%, identified animals displayed in the zoo by species name. This number increased on the posttest to 165 or 21.3% of the responses. Participants were able to correctly identify more animals displayed in the zoo by species name after the field trip.

In addition to an increase in use of species name on the posttest, the number of animals identified by genus also increased significantly ($\alpha = .05$). The number of responses in the genus category increased from 17% to 27% and the mean increased from 1.67 to 2.7. As the number of responses in the species and genus categories increased, the number of broader classifications such as family, order, and class decreased. significantly ($\alpha = .05$). The number of responses in this category decreased from 59% to 41% or from a mean of 3.71 to 3.35. However, this decrease was not significant ($\alpha = .05$). Table 4-5 provides a summary of the percentages.

Table 4-5. Summary of animal classification categories

	Species	Genus	Family/Order/Class
Pretest	24.2%	17%	59%
Posttest	31.3%	27%	41.3%

A second analysis was done with the species category and the genus category combined. A t-test was conducted on that species/genus score and the family/order/class score. On the pretest the means were almost equal, 3.72 and 3.71 and there was no significant difference ($\alpha = .05$). On the posttest there was a significant difference between the means ($\alpha = .05$). Participants were more likely to identify an animal by species/genus name (mean = 5.56) than by family/order/class name (3.35).

The content analysis also revealed interesting results in regards to the participants' experience at the zoo. By far the largest component of the participants'

schema for the zoo is animals. Out of 1028 concepts on the pretest, 721 or 70% were animals. On the posttest, this number increased slightly to 866 concepts out of 1105 or 78%. Other concepts that the participants related to the zoo were positive and negative affect, natural features, man-made features, people, food, actions or activities that occur at the zoo, descriptors, learning or school related terms, and scientific terms. The use of these other terms show that the trip to the zoo is not just about the animals but the overall experience that the trip provides.

Within the animal category, there was a wide variety of animals identified. The animals identified fell into the following categories: birds, cats, primates, reptiles and other cold-blooded animals, insects, aquatic animals, wild and domestic hoofstock, predators, and a group of miscellaneous mammals. Table 4-6 provides a summary of the animal category frequencies. By far the most commonly identified groups are the birds, cats, and reptiles.

Table 4-6. Summary of frequencies in each animal category

Category		Pretest	Posttest
Birds		112	156
Cats		128	107
Primates		53	87
Cold-Blooded	Reptiles	94	130
	Others	25	27
Insects		10	8
Wild Hoofstock		79	83
Domestic Hoofstock		27	39
Other Predators		38	74
Aquatic Animals		32	70
Misc. Mammals		72	42

Within the bird group, the most commonly identified birds on the pretest were eagles and owls, mentioned 11 and 10 times respectively. Tigers, 46, and lions, 40, were the most identified cats and the bear, 22, was the most common of the other predators. In the primate group, the general term monkey, 38, was the most often used. The general term snake, 24, was the most often used in the reptile group followed by alligators, 22. Elephants, 25, were the most popularly identified wild hoofstock and the pig, 10, was the most identified domestic hoofstock. Within the aquatic group, the manatee, 20, was the most mentioned animal. The miscellaneous mammal group had a wide variety of smaller mammals in it. The most popularly mentioned were the bat, 11, and the koala, 9.

On the posttest, the most common animals mentioned remained the same in the bird, cat, primate, aquatic animal, and cold-blooded animal groups. The only major changes occurred in the wild hoofstock group, domestic hoofstock group, and the miscellaneous mammals group. The most commonly mentioned wild hoofstock changed from elephants to bison/buffalo. The domestic hoofstock changed from pigs to goats and horses. Within the miscellaneous mammal group, the most mentioned animals changed from bats and koalas to Tasmanian Devils.

The statistical analysis for Hypothesis 3 showed there was no significant difference between the cognitive pretest and posttest. However, a closer examination of the concepts shows that the participants were gaining something from the experience. These observations demonstrate that the participants' had a better understanding of the Lowery Park Zoo and that the trip was an experience comprised of many components.

Hypothesis 4 and Hypothesis 5

To test Hypothesis 4: there is no significant differences in performance on the cognitive measure based on level of curiosity, and Hypothesis 5: there is no significant difference in performance on the cognitive posttest based on race, gender, prior knowledge, or prior visitation to the zoo, a single multiple regression was used. Regression analysis was used to determine the relationship between the dependent variable, cognition, and the independent variables, curiosity, race, gender, prior knowledge, and prior visitation to the zoo. Table 4-7 provides a summary of the multiple regression analysis.

There were no significant differences in cognition based on curiosity, race, gender, or prior visitation to the zoo ($\alpha = .05$). Prior knowledge or the cognitive-concept pretest score did have a significant effect ($\alpha = .05$) on the cognitive-concept posttest score. Hypothesis 4 was not rejected and Hypothesis 5 was rejected only for prior knowledge.

Table 4.7. Summary of regression analysis predicting cognition

Parameter	Estimate	Standard Error Of Estimate	T for HO: Parameter =0	Pr > | T |
Intercept	4.609643206	4.49669604	1.03	0.3085
Preconcept	.922445915	0.11312489	8.15	*0.0001
Precuriosity	-0.870745752	1.05605484	-0.82	0.4122
Gender 0	1.771724918	1.70867704	1.04	0.3030
1	0.000000000	-	-	-
Race 1	.665477941	1.94814052	0.34	0.7336
2	1.669557310	5.55417480	0.30	0.7645
3	0.000000000	-	-	-
Trips 0	-0.250507016	1.84764957	-0.14	0.8925
1	0.000000000	-	-	-

* = Significant results ($\alpha = .05$)

Affect

As a measure of participants' attitudes and perceptions about animals, they were asked to report which animal at the zoo was their favorite and which animal at the zoo they liked the least. Along with the animals' names, the participants were asked to provide a reason why they liked or disliked the animals. Previous research has shown that certain types of animals are consistently liked and others are consistently disliked. For instance, research has shown that mammals and birds are liked but cold-blooded animals such as reptiles are disliked. Based on the previous research and content analysis, participants' responses and reasons were grouped into categories. The frequencies for each category were used for the data analysis. Hypothesis 6 is related to affect.

Hypothesis 6

Chi-square tests of significance and Chi-square tests of significance with Yates Correction for Continuity were used to test Hypothesis 6: there is no significant difference between students' pretest and posttest preference for certain animal types. The animals that participants liked and disliked fell into the following categories: cats, other predators, primates, cold-blooded animals, birds, other small mammals, and hoofstock. The frequencies for each of these groups are reported in Table 4-8.

On the pretest, there was a significant difference ($\chi^2_{obs} = 65.44$, $\alpha = .05$) between the categories of animals that the participants reported to like and dislike. Participants liked cats and primates more than they liked cold-blooded animals, birds, or hoofstock. Small mammals had to be dropped from analysis due to low expected frequencies.

Table 4-8. Frequencies of animal categories

		Cats	Other Predators	Primates	Cold-blooded animals	Birds	Small Mammals	Hoofstock
Pre Test	Like	40	3	19	6	7	6	3
	Dislike	3	2	3	21	15	6	19
Post Test	Like	46	6	20	10	5	2	3
	Dislike	0	9	12	18	10	4	21

The same significant results were found on the posttest ($\chi^2_{obs} = 58.95$, $\alpha = .05$). Cats and primates were the most liked and the animals most disliked were cold-blooded animals and hoofstock. Small mammals and birds had to be dropped from the posttest analysis due to low expected frequencies. However, the observed frequencies for birds were in the same direction as the pretest. There was no significant difference between animals liked and disliked based on gender or race.

In relation to the above analysis, there was no significant difference in the categories of animals liked between the pretest and posttest. The animals that were liked most, cats and primates, remained the same on the pretest and the posttest. The same was true for the animals disliked most. They remained the same on the pretest and the posttest. Hypothesis 6 was not rejected.

The reasons given for liking animals fell into the following categories: physical characteristics/activity, affective physical attributes, "cool," and "I like them." The physical characteristics/activity group included the animal's strength, speed, and types of activity. Affective physical attributes included aesthetically pleasing attributes such as being "cute" or "pretty" and characteristics of the animal's physical appearance such as color. Some participants did not provide a reason for why they liked the animal. Table 4-9 provides the frequencies for the reasons that participants liked an animal.

Table 4-9. Frequencies for reasons animals are liked

	Physical Characteristics	Affective Attributes	"Cool"	"I like them"
Pretest	24	18	6	5
Posttest	10	27	5	1

Between the pretest and the posttest, there was a significant difference in the reasons given for liking an animal ($\chi^2_{obs} = 7.246$, $\alpha = .05$). On the pretest more of the reasons fell into the physical characteristics group and on the posttest more of the responses were based on the affective attributes. "Cool" did not contribute much to the significance because the response rates were almost even. "I like them" had to be dropped due to low expected frequencies.

In order to test the relationship between responses and gender, the pretest and posttest scores were combined to increase the expected frequencies to acceptable levels. There was a significant difference ($\chi^2_{obs} = 19.51$, $\alpha = .05$) between reasons an animal was like based on gender. More males gave physical characteristics/activities as the reason they like an animal and females gave more affective attributes. Table 4-10 gives a summary of the frequencies by gender.

Table 4-10. Frequencies by gender for reasons animals are liked

	Physical Characteristics/ Activity	Affective Attributes
Male	31	10
Female	10	32

The reasons for disliking animals fell into the following categories: physical characteristics/activity, negative affective attributes, and "I don't like them." The

majority of the physical characteristics/activity groups was composed of statements about the animals activity or inactivity such as “they don’t do anything” or “all they do is fly.” Negative affective physical attributes included “ugly,” “smells bad,” and “looks mean.” A fourth category for disliking an animal was only found for the pretest. This category was for responses that classified animals as dangerous or scary. Some participants did not provide a reason. Table 4-11 provides frequencies for the reasons for disliking an animal.

Table 4-11. Frequencies for reasons animals are disliked

	Physical Characteristics	Affective Attributes	“I don’t like them”	Dangerous/Scary
Pretest	14	15	1	11
Posttest	24	16	2	0

There was a significant difference ($\chi^2_{obs} = 14.28$, $\alpha = .05$) between the pretest and posttest for reasons animals were disliked. On the posttest, more physical characteristics/activities were mentioned than on the pretest. The pretest had the dangerous/scary category which had no responses mentioned on the posttest. The affective attributes frequency was even between pretest and posttest so this category did not contribute to the significance. “I don’t like them” had to be dropped from the analysis due to low expected frequencies. There was no significant difference for gender between categories. It is interesting to note that even though the numbers were not significant, they were in the same direction as for the like category. Females gave more affective responses and males gave more physical characteristics/activity responses. Table 4-12 provides a summary of the frequencies by gender.

Table 4-12. Frequencies by gender for reasons animals are disliked

	Physical Characteristics/ Activity	Affective Attributes
Male	22	13
Female	16	18

There were also significant differences for reasons between the like and dislike responses. These responses were significant for the pretest ($\chi^2_{obs} = 13.46$, $\alpha = .05$) and the posttest ($\chi^2_{obs} = 4.05$, $\alpha = .05$). On the pretest, more participants described physical characteristics for liking animal rather than disliking. Being dangerous/scary was only given as a reason for disliking an animal. Affective attribute reasons were equally represented for liking an animal. Table 4-13 provides the frequencies for the pretest.

Table 4-13. Pretest frequencies for reasons animals are liked versus disliked

	Physical Characteristics/ Activity	Affective Attributes	Dangerous/ Scary
Like	24	15	0
Dislike	14	15	11

On the posttest, more physical characteristics/activities were given for disliking an animal and more affective attributes were reported for liking the animals. Overall, however, on the posttest more affective responses were given than physical attributes. Dangerous/scary was not mentioned on the posttest. Table 4-14 provides the frequencies for the posttest.

Table 4-14. Posttest frequencies for reasons animals are liked versus disliked

	Physical Characteristics/ Activity	Affective Attributes
Like	10	35
Dislike	16	24

Prior Knowledge

Prior knowledge is an important factor to consider because previous research has shown that it has a significant impact on future learning. Prior knowledge has already been tested as an independent variable in earlier analyses. This analysis is to determine the relationship between prior knowledge and prior visitation. Participants who have visited the zoo before will have prior knowledge about the zoo environment that non-visitors will not have. These participants may have had a schema for the zoo, which may have facilitated learning in this environment. The hypothesis related to prior knowledge is Hypothesis 7.

Hypothesis 7:

To test Hypothesis 7: there is no relationship between prior knowledge and previous visitation to the zoo, a Pearson correlation coefficient was applied. The correlation coefficient provides a measure of the strength of association between the two variables, prior knowledge and prior visitation to the zoo. The correlation coefficient between prior knowledge and prior visitation was .19. There was a very small positive relationship between prior visitation and prior knowledge. Only 3.6% of the variability in prior knowledge was due to prior visitation to the zoo. Hypothesis 7 was not rejected

since there was such an insignificant relationship between prior knowledge and prior visitation.

Summary

For this study, participants completed curiosity, cognitive, and affective measures. The results of these measures along with student data obtained from school records were analyzed to test seven null hypotheses. One of the seven hypotheses was rejected. Out of the five independent variables for Hypothesis 5, there was a significant difference for one. There was a significant difference ($\alpha = .05$) in performance on the cognitive posttest based on prior knowledge. There was no difference in performance on the cognitive posttest based on race, gender, curiosity or prior visitation to the zoo.

Even though there was not an increase in the number of concepts reported by participants, there was a significant difference in the types of concepts reported on the pretest and posttest. For instance, participants could identify more animals displayed by the zoo after the trip than they could before the trip. Furthermore, the animals were identified at a more specific level of scientific classification. More animals were identified on the posttest by species and genus name than on the pretest.

The zoo field trip did not significantly affect participants' attitudes towards certain types of animals. Therefore, Hypothesis 6 was not rejected. However, these data show that children do have certain preferences for animals and that these preferences are consistent. The reasons that the children preferred certain animals did change. There were significant differences between the pretest and posttest in reasons why animals were

liked. There also were significant differences between the pretest and posttest in reasons why animals were disliked.

CHAPTER 5
DISCUSSION

A field trip to a zoo was examined for its impact on three educationally important variables: curiosity, cognition, and affect. Specifically, this study was designed to investigate a) differences in cognitive learning as a result of the zoo field trip, b) if the trip to the zoo had an impact on curiosity, c) the role curiosity plays in learning, d) the effect of gender, race, prior knowledge and prior visitation to the zoo on learning and curiosity, e) participants' affect for different zoo animals, and f) if prior visitation to the zoo contributes to prior knowledge.

A framework (Figure 2-1) developed by Koran & Koran (1986a) guided the design of this study. Each of the study's independent and dependent variables falls into one of the framework's categories: characteristics of the visitor, visitor processing activities, exhibit type, or desired outcomes. The framework illustrates the interaction of the variables and the importance of contemplating all variables when conducting research.

Curiosity was the principal independent variable of interest because it has frequently been cited as a factor that can lead to increased learning (Fire, 1985; Koran et al., 1989; Messick, 1979). Koran et al. (1984) have used the learning and memory model (Figure 2-2) to explain how curiosity impacts the critical first step of attention and consequentially learning in informal settings (Koran et al., 1989).

Based on the learning and memory model (Koran et al., 1984), previous research (Arnone et al., 1994; Inagaki, 1978; Maw and Maw, 1964), and schema theory (Dochy, 1990), it was hypothesized that children with higher curiosity levels would demonstrate, by being able to recall more concepts, higher learning levels from the field trip than low curiosity children. It was also hypothesized that the zoo was an environment that would enhance and support curiosity, thereby increasing curiosity levels in all participants.

Curiosity

Hypothesis 1

The purpose of Hypothesis 1: there is no significant difference between the pretest and posttest curiosity measures, was to explain whether the field trip to the zoo had any impact on curiosity. There was no significant difference found between the pretest and posttest measure and Hypothesis 1 was not rejected. Before the trip to the zoo, the participants, overall, were very curious about the zoo animals. The mean for the curiosity pretest was 3.92. After the trip, the participants were still curious. The mean for the curiosity posttest was 3.77.

These findings demonstrate that fourth and fifth grade students are very curious about zoo animals. Research has shown that in school curiosity actually decreases with age (Engelhard & Monsaas, 1988; Gold & Henderson, 1990; Shumakova, 1992). Curiosity is less encouraged in the fourth and fifth grades than in younger grades (Engelhard, 1985). It is promising to see that at a time when curiosity is being less encouraged in school, students do have relatively high curiosity levels for some subject matter.

As encouraging as it was to find high levels of curiosity, it was disappointing to find that the trip had no significant impact on curiosity. There are several reasons why this may have occurred.

The researcher and additional observers were at the zoo on the day of the field trip. We observed that teachers allowed the students to stay at exhibits for only brief periods of time. The students were in large groups and were quickly ushered from one exhibit to the next. The large groups inhibited children in the rear and sides from seeing the entire exhibit. Therefore, individuals had very little time to attend to the exhibits. Research has shown that children terminate instances of curiosity on their own (Cantor, 1976). Unfortunately, in this case the instances were terminated for them.

An explanation for no significant change in curiosity combined with the observations resides within the learning and memory model (Figure 2-2) (Koran et al., 1984). Curiosity functions in one of two ways. It is either the response to a stimulus, which in turn functions to encourage students to use their senses to attend to the stimulus, or it acts as a stimulus to influence attention, expand perception, and enhance encoding (Koran et al., 1984). Since students were given such little time to interact with stimuli, curiosity may not have been evoked. There was no time for participants to respond to the stimulus with curiosity. Since there was no time for curiosity to be a response to a stimulus, then it could not be reinforced (Koran & Longino, 1982).

The second possible role of curiosity may be more significant for the current study because the students were curious about the animals before they went to the zoo. Therefore, curiosity was the stimulus. Because of the way teachers moved the students past exhibits, there was no time for the students to interact with the exhibits and for

curiosity to focus attention on the information in the labels or for sufficient observations of the animals.

Epistemic curiosity is aimed at increasing one's knowledge (Moch, 1987). Students entered the zoo wanting to know more about the animals. Without being able to read the exhibit labels or observe the animals, the students could not obtain information to answer their current questions. Answers to current questions would have lead to further questions as students realized there was more to learn (Lowenstein, 1994). Hence, there would have been increased curiosity levels in all students.

Since these students are unique because they are in a dropout prevention program, it is important to compare them to students in a traditional elementary school. A pilot study was done at P.K. Yonge Elementary School, a laboratory school at the University of Florida. The P.K. Yonge students scored 3.79 and 3.72 respectively, on the pretest and posttest. These scores are very similar to the participants' scores, 3.92 and 3.77. This does not completely rule out differences between the two populations. However, the participants were not different from the pilot study students in their curiosity levels.

The similarity between the pilot students' and the participants' scores lead to another possibility. Since the participants scored insignificantly higher on the pretest than the posttest and the rest of the pilot and study curiosity scores were the same, perhaps the students were scoring around some optimal level. There is an optimal level of curiosity that maintains the arousal necessary for efficient learning (Sussman, 1989). Figure 2-3 can be used to visualize this level (Day, 1982). Students may be scoring around the optimal level of epistemic curiosity for zoo animals. Anything higher may cause anxiety and anything lower may cause boredom (Day, 1982; Sussman, 1989).

Individuals differ in where their optimal level occurs. This optimal level may be causing a ceiling effect. Individual scores might change either by increasing or decreasing slightly but the mean score will always be around the optimal level.

Another explanation may be that the students' curiosity stabilized because of exposure to the stimuli (Jenkins, 1969). Research has shown that curiosity stabilizes over time due to exposure and curiosity does not increase to a high level (Jenkins, 1969). Participants' curiosity may have stabilized because of repeated exposure to stimuli over the course of the field trip and consequently could not become higher.

It was hypothesized that a trip to the zoo would increase curiosity levels in all participants. The results show that there was no significant difference between the pretest and posttest. This may have been caused by any of a number of reasons. The most likely of which was the termination of participants' interaction with exhibits by the teachers. Without sufficient time, curiosity could not be evoked and subsequently foster higher levels of curiosity.

Hypothesis 2

The purpose of Hypothesis 2 was to determine if there was a significant difference in students' curiosity based on gender, race, prior knowledge, or prior visitation to the zoo. Overall, research on gender effects on children's curiosity has been inconclusive (Maccoby & Jacklin, 1974). Some research, such as that done by Schneider (1987) and Rabinowitz et al. (1975), have found that boys manipulate novel objects more frequently than girls causing boys to appear more curious. Others have shown that girls are more curious than boys (Maccoby & Jacklin, 1974).

The current study supports the literature showing no differences in curiosity based on gender. For example, Engelhard & Monsaas (1988) found no difference in school-related curiosity between genders. There also have been many other studies with children from 6 months to 18 years that have shown no differences in curiosity based on gender (Maccoby & Jacklin, 1974). Cumulatively, the results of all the studies could indicate that differences in curiosity based on gender might be due to the different types of curiosity measured. Differences between genders have been found more for psychomotor curiosity than epistemic. Boys may be more curious psychomotorly. Another possibility is that the inconsistent findings are caused by differences in measurement, procedures, and stimuli.

There has been less research conducted on differences in curiosity based on race. Like the gender research, the research that has been done has had variable results. Past research on race has shown that there may be differences in psychomotor curiosity. Peterson & Lowery (1972) found differences in psychomotor curiosity behavior between African American and Caucasian children. Catherwood (1988) also found cultural differences in psychomotor curiosity. Aboriginal children manipulated a novel object at a higher rate than Caucasian children. However, Australian Aboriginal children and Caucasian children displayed similar levels and patterns of visual curiosity.

Shumakova (1992) found differences in Russian and American children's epistemic curiosity as shown by the predominance of different question types. The current research did not find differences in epistemic curiosity when comparing African American and Caucasian children. Perhaps, zoo animals are a topic that will transcend cultural and gender differences and arouse curiosity in most individuals. On the other

hand, the inconsistent results found not only among the research done on cultural differences but also on sex differences may be due to differences in tasks, stimuli, instrumentation, and measurement.

According to Berlyne, curiosity is aroused more often by stimuli that are partially familiar rather than stimuli that are completely unfamiliar or familiar (Berlyne, 1966b). Research analyzing questions asked by children supports this belief (Vidler, 1977). Children were found to be more curious about things that they had encountered in some form in their own experiences and avoid the extremes of complete novelty or complete familiarity (Vidler, 1977). Koran, et al. (1989) did find that exhibits with less commonly known content elicited little attention. Since there is a relationship between curiosity and attention (Figure 2-2) (Koran et al., 1984), these results may also support Berlyne's view of curiosity (Koran et al., 1989).

The current research explored the relationship between prior knowledge and curiosity, and prior visitation and curiosity. It was believed that the participants' familiarity with the topic (prior knowledge) or familiarity with the site (prior visitation) would influence their curiosity as Berlyne suggested. Low prior knowledge or high prior knowledge would cause the animals to be too novel or too familiar, respectively. Contrary to what was expected, neither prior knowledge nor prior visitation influenced the participants' curiosity.

Perhaps the results from the test used to measure the participants' prior knowledge were not a true reflection of their familiarity with the animals. All the participants were required to do was list words; hence, the majority of them solely listed animal names. There was no exploration into how much they knew about each animal

just that they knew what the animal was. Birney & Shaha (1982) did find a significant correlation between the level of familiarity a person had with an animal and the amount of knowledge the person demonstrated about the animals. However, their tests were more structured than the one used in the current study and probed for more information about individual animals.

Cognition

Hypothesis 3

There has been very little research done to investigate growth in knowledge after trips to the zoo (Braverman & Yates, 1989). Therefore, the purpose of Hypothesis 3, there is no significant difference between the pretest and posttest cognitive measures, was to determine if there was a gain in knowledge caused by a trip to the Lowery Park Zoo. The research found that there was no significant increase in knowledge as measured by the number of relevant concepts participants produced.

Again, this lack of significant difference may be caused by the termination of participants' interactions with the exhibits by the teachers. On average, participants only spent 50 seconds at an exhibit. Many of the students did not get to see the exhibits up-close because they were at the back or sides of a large group. Falk (1983) found that both behavior and time at an exhibit are important for learning from the exhibit. A certain quantity as well as quality of interaction are necessary for learning to occur. His results showed that children who spent a reasonably long time at an exhibit and showed positive behaviors demonstrated concept learning (Falk, 1983). The participants in the current

study had neither a sufficient amount of time to interact with the exhibits nor an adequate quality of interaction. Consequently, there may not have been concept learning.

While there was no significant difference in the number of concepts reported, there were significant differences in the types of concepts reported. For instance, participants were able to identify more animals that were displayed by the zoo after the trip than before. Furthermore, the number of animals identified that were not displayed by the zoo decreased. Participants did not increase the number of concepts they identified but their responses were more accurate.

Before entering the zoo, each participant had a schema for the zoo in which related concepts were stored (Dochy, 1990). Certain animals were part of this schema and participants expected to see them during the trip. As an individual encountered new animals at the zoo, the animal was either assimilated or accommodated into the existing schema. There was a reorganization of the participants' knowledge and their schema for the zoo became a more accurate reflection of the Lowery Park Zoo. Therefore, participants were learning on the field trip. However, this learning could not be measured as an overall increase in knowledge but rather a change in knowledge.

This change also can be seen when examining the number of responses for individual animals. For example, on the pretest the tiger was mentioned 46 times and the lion was mentioned 40 times. The Lowery Park Zoo displays tigers but does not display lions. On the posttest, tigers were mentioned 63 times and lions were only mentioned 21 times. Because of the wording of the test, participants were not trying to explicitly think of Lowery Park Zoo animals but the change in their zoo schema still occurred. For others, the lion may be so strongly related to zoos that even though participants did not

see one on the trip, they still associated the lion with the zoo and reported it on the test. Other changes in schema occurred for the wild and domestic hoofstock groups and the miscellaneous mammal group. The most common animals identified by the participants changed from animals that the zoo did not have to animals that were present in the zoo. For example, in the wild hoofstock category the most common animal identified changed from elephant on the pretest to buffalo/bison on the posttest. The zoo does not display elephants but does have bison/buffalo.

Other striking examples are the changes within the primate group. The Lowery Park Zoo has a whole exhibit area devoted to primates and one would expect them to be a large part of the zoo experience. As expected, the number of primates mentioned increased from the pretest to the posttest. What was really noteworthy was the mention of lemurs and orangutans on the posttest. These animals are not common animals or animals that children are familiar with. It was not surprising that the participants did not mention either of them on the pretest but was encouraging to see them mentioned on the posttest. Also, on the pretest, chimpanzees and baboons were each mentioned once. These increased to 6 and 15, respectively, on the posttest.

The animals themselves may be causing these changes in participants' schema. Birney (1986) found that the animals subjects could recall from their visit were the active ones. Other research also has shown that animal activity increases the amount of time visitors spend with an exhibit (Altman, 1990; Bitgood et al., 1986; Lessow, 1990). Increased attention will allow for the processing of information into long-term memory (Koran et al., 1984). This was particularly true for the tigers. The tigers were three month-old cubs that were just introduced into their enclosure and they were very active.

In addition to their activity level, they had other characteristics, such as being attractive and young, that Bitgood et al. (1986) have identified as increasing attention. Altman (1990) reiterates these observations by stating that "learning will focus on the particular quirks, peculiarities and behavioral idiosyncrasies of animals and the visitor's subjective reaction to them" (Altman, 1990, p 54).

Participants also identified more animals by species and genus on the pretest than on the posttest. As the number of species and genus names increased, the number of broader classifications, family/order/class, decreased. For instance, on the pretest some participants identified eagles and bears as animals that could be found at the zoo. On the posttest, participants identified bald eagles and black bears as animals found at the zoo. The Lowery Park Zoo displays both of the species. The participants were learning how to identify animals by species and genus names.

Falk & Dierking (1997) report that the lack of significant differences in learning found in previous studies was due to the narrow definition of learning – the recitation of facts and concepts. The test used for this study was selected exactly for that reason. It was designed to sample a broad range of a participant's knowledge and the individuality of that knowledge (Falk et al., 1998). What exactly the participants' learned varied, the degree of change was what was comparable (Falk et al., 1998). This test proved to be extremely useful. Other tests may not have shown that students were learning something on the field trip, just not what was expected. If the teachers had organized the trip better so that it could have been more productive for the students, learning, defined as a gain in knowledge may have occurred. However, by being able to identify the animals at the zoo students were learning at a very basic level.

Participants' responses also support research demonstrating that a trip to an informal setting is a social experience (Falk & Dierking, 1992; Lessow 1990; Parsons & Muhs, 1996). Their day was not simply composed of viewing the animals but involved interacting in social groups amongst their peers, and with chaperones and zoo personnel. Many of the participants' responses to people, food, and actions and activities that take place in the zoo reflect the social experience.

Falk & Dierking (1992) developed a framework that describes not only the social references but also participants' other references as well. Participants' other references included man-made and natural features of the zoo. Man-made features included cages, picnic tables, the petting zoo, and gift shops. Natural features included trees and water. There was also a group of responses that were about the zoo's animal shows.

The Falk & Dierking (1992) framework conceptualizes the zoo visit as involving the interaction of three contexts, personal, social and physical. The personal context includes an individual's interests, motivations, and experience in and knowledge of the content and design of the zoo. The personal context would include participants' knowledge of and about the animals. References to people and activities done at the zoo would fall into the social context. The physical context includes the architecture and the "feel" of the setting (Falk & Dierking, 1992). The current research demonstrates that a trip to the zoo truly is about the experience. For the participants, the trip was not just about the animals but was composed of the different contexts.

Hypothesis 4 and Hypothesis 5

The purpose of Hypothesis 4 was to determine if there was a significant difference in performance on the cognitive measure based on level of curiosity. Many researchers believe that curiosity is important for learning and concept attainment (Harty & Beall, 1985; Koran, et al. 1989; Neal, 1970; Messick, 1979). It is considered a prerequisite to learning and problem solving (Bradbard et al., 1988). There has been some evidence substantiating curiosity's effect on learning outcomes (Alberti & Witryol, 1994; Henderson & Moore, 1980; Inagaki, 1978; Maw & Maw, 1961).

Based on previous research, it was hypothesized that curiosity level would impact learning during the zoo field trip. It was also believed that high curiosity students would out perform low curiosity students because they would spend more time with a stimulus and explore it with more of their senses (Koran & Longino, 1982). Contrary to what was expected, in the current research, there was no relationship between curiosity and performance on the cognitive posttest.

Fire (1985) also found that curiosity did not have a significant effect upon learning from an exhibit in an informal setting. As in the current study, Fire used a single paper and pencil test to measure curiosity. Since curiosity is a not a unitary construct, it may be necessary to measure it with more than one method (Kreitler et al., 1975). Another proposed measure of epistemic curiosity is question-asking (Koran & Longino, 1982). Asking questions is considered one of the main expressions of epistemic curiosity (Moch, 1987). Question-asking has been used successfully as a measure of epistemic curiosity in a classroom (Torrance, 1970), in a science center-like setting (Peterson &

Lowery, 1972) and in a museum (Marsh, 1978). Unfortunately, the relationship between curiosity and cognition was not investigated in these studies.

Hypothesis 5 tested for significant differences in performance on the cognitive posttest based on race, gender, prior knowledge, or prior visitation to the zoo. There were no significant differences in cognition based on gender or race. Previous research had shown that females (Westervelt & Llewellyn, 1985) and African Americans (Kellert, 1985) in general, were less knowledgeable about wildlife than males or Caucasians. As was discussed with Hypothesis 2, the inconsistency between the current study and other studies could be caused by the difference in instruments used. For example, Kellert (1985) used a 33 item multiple choice/true false test, an identification test, and questions about animal diets. His study investigated the knowledge base of its participants at a much more in-depth level than the test in the current study.

There was also no significant difference in cognition based on prior visitation to the zoo, which was thought to contribute to cognition in two ways. First, repeat-visitors would be able to spend more time on-task and less time exploring the environment because it was not novel to them (Balling & Falk, 1982; Falk et al., 1978). Second, the repeat visitors would have already had a schema (prior knowledge) for the zoo making it easier to assimilate or accommodate new information.

There was a significant relationship between prior knowledge and performance on the cognitive posttest. Previous research has shown that prior knowledge explains between 30 and 60% of the variance in posttest scores (Dochy, 1990). These results are obtained because existing knowledge at the onset of instruction plays a very important

role in learning from instruction (DeKlerk, 1987). The results of the current study confirm the importance of prior knowledge to future performance on a cognitive task.

Researchers in informal settings have also recognized the importance of prior knowledge. For example, Koran & Schafer (1982) have stated that the most important factor that will determine what an individual learns during an informal science experience is prior knowledge. Visitors will interpret exhibitions using their own background experience, knowledge and interests (Milan, 1995).

Affect

Hypothesis 6

Zoos want to elicit an affective response from their visitors (Berkovitz, 1988). Not only are zoos trying to produce an affective response in their visitors but they also are trying to change negative responses about particular animals to positive ones. Therefore, Hypothesis 6 tested for significant differences between students' pre and posttest preference for animal types. One indicator of affect toward an animal is whether that animal is liked or disliked (Mueller, 1986). An advantage of this indicator is that it can be asked in a straightforward question, unlike some attitude scales.

Several studies have looked at preferences for different types of wildlife (Bart, 1972; Collins, 1976; Morris, 1960; Surinova, 1971; Westervelt & Llewellyn, 1985). This research has shown that certain groups of animals are consistently liked and disliked amongst various study populations. Comparisons between previous research and the current research should be done cautiously though since in previous studies participants were given lists of animals and asked to report if they liked or disliked each one. In this

study, the questions were open-ended and participants could report only one animal they liked and one animal they disliked.

The categories of animals for the current research also are slightly different from previous research. Cats were so popular in the current research that they were given their own category instead of being lumped with predators. With that in mind, the current research was similar to previous research, showing that mammals and large animals are favored. Specifically, cats and primates were liked. However, other large mammals such as hoofstock that were liked in previous studies were not liked in the current study. Bitgood et al. (1986) found that the attracting power and holding power for hoofstock were low. For some reason, hoofstock in zoos are not attractive to visitors.

Another inconsistency between previous studies and the current study is how birds were rated. Birds were ranked highly in previous studies but in the current study more participants disliked them. Insight into this discrepancy comes from the reasons participants reported for disliking birds. They disliked them because they "don't do anything," or "only fly around and around." Foster et al. (1988) suggested that a lower attracting power for birds was due to visitors' frustrations while observing them. Participants in the current study did not like the birds because they were conceptualizing, as they were instructed to, zoo birds. Participants in other studies were conceptualizing wild birds.

Animals that other studies have found to be unpopular were predators, small animals, and cold-blooded animals (snakes). The results from this study also show that cold-blooded animals in general and snakes in particular are disliked. The numbers

reported for predators other than cats and small mammals were too small to use in the data analysis.

There was no change in the categories of animals liked and disliked from the pretest to the posttest. Animals that were liked the most on the pretest were still liked the most on the posttest and animals disliked on the pretest were the same ones disliked on the posttest. When comparing animals in all categories, there was no significant change in participants preference for certain animal groups. Therefore, Hypothesis 6 was not rejected.

A closer look at the numbers reveals that the numbers for hoofstock essentially stayed the same. Many participants disliked them and very few participants liked them on both the pretest and on the posttest. In contrast, the numbers for cold-blooded animals changed slightly in a positive direction. There was an increase in the number of participants from the pretest to the posttest that reported to like them and a decrease in the number who reported to dislike them. The frequencies reported were too small to test for significance but the zoo may be having some effect on affect within this category.

There were no differences in preferences for animals based on gender or race. Westervelt & Llewellyn (1985) found that there was a significant difference between genders in preference for animals. Collins (1976) also found a difference between the types of animals that males and females liked and disliked. The discrepancy between past research and the current research may be due to differences in the type of testing. In past research, participants were asked to rate specific animals across a range of wild and domestic animals. In the current research, participants were asked to pick their most and least favorite animal from the zoo. The only literature that examined the role of ethnic

differences in preferences of animals found a difference between Czechs and Britains on animals that were liked but not for animals that were disliked (Surinova, 1971).

Participants were asked to explain why they liked or disliked the animals they reported. The responses were categorized into groups based on physical characteristics/activity, affective attributes, and how dangerous/scary the animal was. Males and females reported different reasons for liking and disliking animals. Females, more than males, liked and disliked animals for affective reasons. They liked animals because they are "cute" or "pretty" and disliked animals because they were "mean" or ugly. Males, more than females, liked and disliked animals for their physical characteristics/activity. They liked animals because they "run fast" or " are strong" and disliked animals because they "do nothing" or "only fly."

Tunnicliffe (1998) found differences between genders in the conversations they had at zoo exhibits. Girls made significantly more affective and emotive responses than boys did. Boys, on the other hand, made more factual statements and more statements about animal behavior. There are striking similarities between Tunnicliffe's (1998) results and the current research. Girls responded to animals in a more affective/emotive way in both studies. Boys were much more likely to be concerned with animal behavior.

There were significant changes in the reasons given for liking an animal between the pretest and the posttest. The field trip to the zoo caused a shift in reasons for liking an animal from more physical characteristics/activity on the pretest to more affective attributes on the posttest. More participants reporting they liked the tigers on the posttest than on the pretest caused some of this change. The number increased from 4 responses

to 12 responses. Since some of the tigers were cubs, they elicited more comments like "cute."

The significant change in the reasons given for disliking an animal between pretest and posttest was caused by an increase in physical characteristics/activity responses and no dangerous/scary responses on the posttest. The field trip cannot be attributed with changing participants' attitudes about some animals being scary or dangerous. Participants may not have reported these types of reasons because having seen and interacted with the animals, the physical characteristic/activity response was a more outstanding thought. It becomes obvious while examining the list of responses that many participants are disappointed with the inactivity or limited activities of some of the animals at the zoo. Some of the other negative perceptions of the animals were caused by negative human-animal interactions such as the claims that the llamas spit or monkeys threw things at them.

It is important for zoo educators to understand not only which animals are liked and disliked, but why. Many of the reasons given for disliking animals were based on their activity. Lessow (1990) found that once an animal's behavior is perceived as negative, no effort is made to learn more about the species. If zoo educators know which animal is perceived negatively based on its behavior, intervention steps can be taken at two levels. Visitors can be educated about the animal's typical behavior to hopefully change perceptions. And, if necessary, husbandry changes can be made to change stereotypic or negative animal behavior.

Hypothesis 7

Hypothesis 7 investigated the relationship between prior knowledge and previous visitation to the zoo. Falk et al. (1978) have shown that children who are unfamiliar with a field trip setting will learn about the setting while on the field trip but will not learn facts and concepts presented to them during a learning activity in that setting. Children who have been to the site before will be able to learn from the activity (Falk et al., 1978). Repeat visitors do not have to spend as much time exploring the setting and are be able to spend more time involved in on-task behavior (Falk et al., 1978). Therefore, it was assumed that prior visitation would influence prior knowledge in the current study. Having been to the zoo before, repeat visitors were familiar with the site and had a schema for the site as well as some content.

The results show that prior visitation did not impact prior knowledge. The cognitive test asked the students to think about going on a trip to the zoo, not the Lowery Park Zoo specifically. They may have been thinking about any zoo they had previously visited. Since the test was so broad, it may not have been able to distinguish between prior knowledge of any zoo and prior knowledge of the Lowery Park Zoo. Therefore, the content of their answers may not have been impacted by their prior visitation to the Lowery Park Zoo.

Summary

The impact of a field trip to a zoo was measured using curiosity, cognitive, and affective measures. Using the framework developed by Koran & Koran (1986a), the independent variables, race, gender, prior knowledge, and prior visitation to the zoo, were

examined for their effects on the desired outcome, curiosity. Curiosity and the other independent variables were then investigated for their effect on the second desired outcome, cognition. Only gender and race were examined for their impact on affect.

Overall, it was found that the participants were very curious about the zoo animals. This is one advantage that zoos have when trying to educate their visitors. They are teaching a topic that children already want to learn about. Unfortunately, the trip to the zoo did not uniformly foster higher levels of curiosity. This was most likely caused by the way the field trip was conducted. Teachers did not allow the children to spend time with or interact with the exhibits. Therefore, curiosity could not be evoked and reinforced (Koran & Longino, 1982) or augmented (Lowenstein, 1994). Another possibility is that the curiosity levels had reached an optimal level or ceiling and the mean curiosity level could not increase.

Race, gender, prior knowledge, or prior visitation to the zoo did not influence curiosity levels. It was not surprising that there were no gender or race effects. Previous research in both areas has been inconsistent (Catherwood, 1988; Maccoby & Jacklin, 1974; Peterson and Lowery, 1972; Shumakova; 1992).

The trip to the zoo did not cause a significant change between the cognitive pretest and posttest. Learning, defined as a growth in knowledge and measured in the number of relevant concepts reported, did not occur. However, there were significant differences in the types of concepts reported. Participants reported more animals that were displayed by the zoo on the posttest than on the pretest and fewer animals that were not displayed by the zoo. Participants also used more species and genus names for animals and fewer family/order/class names. Therefore, there was a change in the

participants' schema for the zoo. On the posttest, participants had a better understanding of what animals were at the Lowery Park Zoo and of how to identify those animals at the more specific levels of classification.

The field trip to the zoo was not composed solely of viewing animals and exhibits. The trip to the zoo was an experience that involved multiple contexts. Participants reported concepts related to social, physical and personal contexts (Falk & Dierking, 1992).

The relationship between the dependent variable, cognitive performance on the posttest, and the independent variables, race, gender, prior knowledge, and prior visitation, was explored. Race and gender did not have a significant impact on the cognitive posttest. Prior knowledge did have a significant impact on performance on the cognitive posttest. Previous research has substantiated the importance of prior knowledge to future learning (Dochy, 1990).

Prior visitation was expected to impact cognitive performance in two ways. Prior visitation would allow repeat visitors to spend more time on-task (Balling & Falk, 1982; Falk et al., 1978) and prepare repeat visitors by providing them with a zoo schema (prior knowledge). It was found that prior visitation did not influence cognitive performance or prior knowledge. One possible reason for the lack of effect of prior visitation on either prior knowledge or cognition is the way cognition was measured. The participants were instructed to think about going to the zoo, not specifically the Lowery Park Zoo. There was no way to differentiate concepts only related to the Lowery Park Zoo.

Participants had definite preferences for some groups of animals over others. The field trip to the zoo did not change these preferences. The trip to the zoo did influence

the reasons that the participants gave for liking and disliking the animals. More animals were liked after the trip than before because of affective attributes. Being "cute" was an exceptionally important characteristic for being liked.

Participants were very sensitive to the activity levels of the animals in the zoo. The inactivity of animals and certain negatively perceived activities dominated the reasons why participants did not like particular animals after the trip. Males and females responded differently to the animals. More males gave physical characteristics/activity as a reason for liking and disliking animals. Females responded with more affective attribute reasons. These results were consistent with observations from other research (Tunnicliffe, 1998).

Implications and Suggestions

The results of this study showed that students are benefiting from a field trip to the zoo. There was no change in cognition as defined as an increase in the number of concepts reported. However, there was a change in the types of concepts reported. Participants were able to identify more animals from the zoo on the posttest than on the pretest and identified fewer animals that are not in the zoo. Also, on the posttest, more animals were identified by their species/genus names than their family/order/class names. Observations of the students in the field lead to the conclusion that there was no increase in cognition because students were not given enough time to interact with the exhibits.

The implications of these results are that some learning occurs naturally on a field trip but careful planning and preparation is required to insure that learning is related to intended instructional objectives (Prather, 1989). Field trips are enrichment events but

how effective they are as a learning experience as opposed to an entertaining outing depends on how well they are planned (Prather, 1989). Currently, the Lowery Park zoo does not have pretrip, posttrip or during-trip activities for teachers to use. The teachers also did not develop any activities or learning objectives for the students. Only one of the teachers had her students do during-trip activities. Consequently, for most of the students the field trip was an outing not a learning experience based on objectives. The students learned what came naturally: what animals were and were not in the zoo and how to identify them. If zoos have goals and objectives that include students learning in their institutions, they must provide a learning experience for them.

Zoos have the advantage of teaching about a subject matter that students are curious about. Students are receptive to learning about animals because they are already curious and want to know more about them. Zoos can use this curiosity to their advantage by providing experiences that let the students act on their curiosity. They also need to provide experiences that reinforce and augment the natural curiosity in order to perpetuate the learning process.

The results also showed that the trip to the zoo is an experience comprised of many components including a social context. When developing activities, the social component of the trip should be considered. Social interactions can be a determinant of behavior and how students learn (Falk & Dierking, 1992). In addition, cooperative learning may enhance learning.

Also, when developing programs, zoos need an understanding of their visitors' prior knowledge. The current findings support previous research, which has shown that prior knowledge is an important determinant of future learning. Learning builds on

learning. New material is difficult to learn because there is no existing schema to assimilate or accommodate it into. To facilitate learning new information, it can be related to information already existing in a schema.

Zoos intend to foster positive attitudes in their visitors. The current research showed that the students' affect for animals did not change as a consequence of a visit to the zoo. Again, as with cognition, zoos need to develop activities to develop the attitudes they want. Zoos must also be aware of the consequence of displaying animals. There were some students who had negative affective responses toward animals because of how they behaved at the zoo. Zoos need to consider carefully how visitors experience the zoo and perceive the animals. Visitors are not just looking at the animals but at the whole environment and how the animal behaves in it.

For the current research, a cognitive test similar to a personal meaning map was used. This method has a lot of potential for understanding what visitors are learning and experiencing at the zoo. There may have been some downfalls to using the test without interviewing the participants. A true understanding of their familiarity with the Lowery Park Zoo and of their prior knowledge may not have been achieved without the interviews. However, it provided a better understanding of what the participants were learning during the trip and what, other than the animals, the trip meant to them without biasing their answers.

In addition to the PMM, the participants also took two tests on specific animals at the zoo. Prior to visiting the zoo, the teachers were asked to take their students to the exhibits of the Golden-Headed Tamarin and the Colobus Monkey. The students were given posttests with questions based on the animals' exhibit labels. These tests supported

the observational data that the students were not given enough time to interact with the exhibits Students performed poorly on these tests. This leads to the conclusion that the PMM was not necessarily deficient in measuring cognition. The additional tests were not mentioned previously because they were not a factor in the research. They are being used to substantiate that students were not increasing their knowledge during the trip and it was not a matter of inefficient measuring using the PMM. Students did not learn much on the trip because of how it was conducted. This again supports the need for structured activities in order for a visit to the zoo to be more of a learning experience.

The results of this study and past research lead to some specific recommendations for zoos and for teachers who bring their students to zoos on field trips. Some factors that have been suggested as important in contributing to the educational effectiveness of field trips include preparing the students, structuring activities, motivating students, and providing students with feedback (Camp, 1996). Research has shown (Braverman and Yates, 1989; Farmer and Wott, 1995; Stoneburg, 1981) that pretrip and posttrip activities do enhance cognitive performance. Zoos should provide pretrip and posttrip activities for teachers to use. Teachers do not always have time to develop these types of activities for themselves. Teachers appreciate the efforts zoos make on their behalf. It is important for the teachers to use these activities so that their students are maximally benefiting from the field trip.

Zoos should design these activities around state and national curriculum standards. Many teachers still use field trips as an outing or as a supplement to classroom instruction. If designed properly, field trips can be used as part of the curriculum to teach important concepts and ideas. Another important consideration for pretrip activities is to

include orientation materials. Pretrip orientation materials have been shown to enhance learning during a trip more than cognitive materials. Teachers need to tell the students what they will see and experience at the zoo (Balling et al. 1981). Pretrip orientation will also reduce the novelty of the field trip setting which will allow for more on-task behavior and better cognitive gain (Kubota & Olstad, 1991).

The current research showed that a trip to the zoo is an experience that includes social aspects. Zoos should develop programs that facilitate shared learning experiences, encourage children to talk at the exhibits, and encourage discussion and debate (Litwak, 1992). Zoos should also develop activities that require more than one person to participate. With these types of activities, social interaction will encourage and enhance learning. Students should work in small groups to capitalize on the social interactions (Rennie & McClafferty, 1995).

When designing activities, zoos and teachers need to consider how they are going to motivate students. How can curiosity be maintained and increased? Whether being led by a docent or a teacher through the zoo, several factors are important for enhancing curiosity. Children should be allowed to ask questions and should be rewarded not discouraged for asking questions. Teachers and docents need to ask conceptual, probing questions that require thought, not just yes/no questions. Children should be given sufficient time to answer these questions. In the current study, the students were moved quickly from one exhibit to the next without sufficient time for observations or questions.

Most importantly for the teachers, they need to take an active role in planning the trip and assuring that positive outcomes occur. Teachers should visit the sight they are planning on visiting so they know what exhibits they will see and how much time it will

take to visit the whole zoo. If not enough time is available to visit the whole zoo, the teacher can chose which part of the zoo to use that fit with the learning objectives (Rennie & McClafferty, 1995).

Both zoo personnel and teachers need to define their goals and objectives for trips to the zoo (Hoke, 1991). These objectives should be explained to the students prior to visiting the zoo so they act as advanced organizers for the students (Rennie & McClafferty, 1995). Some zoo education programs already incorporate the above recommendations into their programs. For instance, the Minnesota Zoo provides a series of pretrip and posttrip activities for teachers. Other zoos such as the Bronx Zoo and the Brookfield zoo have also developed programs, including teacher workshops, that help teachers maximize the potential of zoo field trips. Research has shown that each of these recommendations will produce a better learning experience for the students. Both zoo personnel and teachers need to consider them when designing school field trips to the zoo.

Limitations

There are several limitations to the generalizability of this study. The participants in this study are unique because they are enrolled in a dropout prevention program at the Robinson Challenge Elementary School. These students are considered at-risk and receive special attention from the school system. Therefore, the results of this study may not be generalizable to students in more traditional schools. The results of this study need to be replicated using participants from a wide range of school settings in order to allow generalization to the larger population of elementary-aged children.

The cognitive test used in the current study was very effective at providing an understanding of what students learned on the field trip. However, this instrument may not have been able to accurately detect differences in prior knowledge because it measured a broad range of knowledge about animals in general. Future research could employ the interview technique described by Falk et al. (1998) to determine prior knowledge more accurately.

No prior research has tested the role of curiosity in learning from a trip to the zoo. However, the curiosity scale developed by Leherissey (1971) has been validated and tested for use in formal learning situations. This study extended the use of this curiosity measure to informal learning situations by making minor adaptations. Even though the test was adapted to measure curiosity about animals, animals have unique attributes not included in the test that may make students curious. A next step in this line of research would be to develop a curiosity instrument specifically designed to ask about these attributes including the animals' behavior. Also, as discussed more fully in the discussion section for Hypothesis 1, subjects in this study had a high previsit curiosity level. This high level may have produced a "ceiling effect" which resulted in no significant increase as a result of the trip because the curiosity level could not increase above this level.

In this study, there were nine teachers and many chaperones who escorted groups of children around the zoo. Each teacher and chaperone had his or her own agenda for the trip. Therefore, the results of this research may not be generalized to other zoo field trips because the exact treatment conditions can not be replicated.

Suggestions for Future Research

The results of this study show that there is still much research to be done not only on curiosity but on learning in a zoo setting as well. Additional research on curiosity about zoo animals could explore age differences in curiosity. Participants of similar age were intentionally used in the current research so age would not be a factor. It is important to find out if epistemic curiosity for zoo animals is similar or different for different age groups. Longitudinal studies could be incorporated into this research to see how curiosity varies as a function of age within cohorts. Some research has shown that attitudes towards animals vary as a function of developmental level (Kellert, 1985). This may also be true for curiosity.

Future research should also investigate differences in curiosity based on learner characteristics other than age. For instance, the results from the current research and a pilot study showed there was no differences in curiosity between the two populations. However, more controlled data should be collected based on differences similar to the differences between these populations. Do curiosity levels differ between gifted children and disadvantaged children? Is there a difference in curiosity for animals based on urban, rural, or suburban residence? Because of the inconsistencies in the gender and race research, this line of research may not be fruitful. However, if it were pursued, very strict guidelines would be needed for using the same instruments, stimuli, and measurements. Boys and girls may indeed express curiosity in different ways. For instance, boys may be more inclined to use psychomotor means to explore a stimulus. More controlled research is needed.

In the current research, curiosity was measured for zoo animals in general. Future research should investigate how curious children are about different groups of animals or specific animals. Then these curiosity levels can be related to cognitive performance and affect. Are children more curious about some animals than others? Are the animals they are curious about the ones they learn about or have a preference for?

More research needs to be done on the impact of the zoo visit on curiosity. Is there an unvarying optimal level of curiosity towards the topic of zoo animals or can curiosity be increased? Future research should be designed with group size and interaction in mind. The current research showed that children were not given enough time or interaction with exhibits because of the size of the groups and the agenda of the teachers. Studies should be designed that allow children to terminate their attention to the exhibits. This may involve using much smaller groups and giving teachers much more explicit guidelines on how to conduct the trip. This could lead to the development of a model field trip for enhancing learning in a zoo setting. Another option is to track individuals throughout their trip to the zoo. Tracking data would provide information on how curiosity changes in response to different situations and exhibit characteristics. Longitudinal studies also could be conducted to measure how curiosity changes as a function of time before and after the trip. It may take more than one visit to change curiosity.

While the observational data did not contribute to any quantifiable results for the current research, it proved to be valuable nonetheless. Without it, it would have been very puzzling to try to explain the insignificant results. Observational data should be included in future curiosity research in informal settings. Not only does the researcher

gain insight into what may have effected the participants' experiences but there also are two types of observational curiosity data that should be recorded. Question-asking at the exhibits can be recorded as a measure of epistemic curiosity. Psychomotor curiosity should be recorded not only for its impact on learning but to investigate its relationship with epistemic curiosity. One problem with the current research was that it might not have captured the full picture of the participants' curiosity. Multiple measures may provide a fuller picture.

Observational data also can be used to record what participants are attending to. The relationship between attention and curiosity can be explored as well as the relationship between attention and retrieval. Do children attend to what they are specifically curious about? Does this increased attention facilitate learning and later retrieval from memory on that specific topic?

Animals in zoos are housed in exhibits. The type of exhibit varies from animal to animal and from zoo to zoo. Do children react differently to the animals based on the differences in exhibit type? Are they more curious about the animal if they can get closer to it? Do immersion exhibits evoke more curiosity than exhibits one walks up to? What role does the exhibit type play in the curiosity response?

Different animals behave differently from one another and individual animals behave differently across time. Do these differences in behavior influence how curious children are? Also, are some children more curious about animal behavior than other children? These types of questions can be addressed by either incorporating them into the current curiosity instrument or developing a separate instrument as well as using observational data.

Do visitors learn at the zoo? The current results suggest it depends on your definition. An overall gain in knowledge, as measured, did not occur. However, there was a significant change in participants' cognition. The instrument used for the current data collection proved useful in the identification of this change. Future research should include the interview techniques used by Falk, Moussouri & Coulson (1998). This would allow a measure of quantitative and qualitative changes. This test also may provide insight into how well children are grasping the abstract/formal concepts such as conservation and extinction that are presented in a zoo. In the current research, participants' responses only included concrete concepts. This technique also would control for the difficulties encountered when investigating the role of prior visitation.

The current research showed some very interesting results for preferences of animals. The results should be replicated using larger numbers of participants. Some categories of animals could not be included in the data analysis because of low expected frequencies. Preferences for animals should also be examined across age groups. Do younger and older children like different types of animals? Are these differences related to developmental stages? Future research should also investigate the impact of visiting a zoo on the affect for the animals and the reasons for this affect. Zoos should look closely at the both the animals liked and disliked and why.

Replication of the gender results found in the current study should be done with larger numbers of participants. Other learner characteristics such as SES and area of residence also should be investigated. Is there a relationship among these variables, preference for animals, and curiosity?

The gender differences found between the reasons animals were liked and disliked should also be replicated. Some research supports these gender differences (Tunnicliffe, 1998). Does the difference in the gender's affective response to the animals influence what they learn about the animals? Do these differences make one gender more receptive to conservation efforts?

Information about visitors' affect can be used to guide the development of zoo education programs and exhibit content. More education programs may need to be developed for animals that are perceived negatively. It is especially important to determine if animal behavior in the zoo is the factor causing these negative perceptions. If so, education programs can be designed to educate people about normal animal behavior. Also, husbandry techniques can be used to try to change abnormal behaviors, for instance, if pacing was an issue.

Given zoos' goals of educating their visitors and changing their attitude for the benefit of wildlife, additional studies of curiosity, attention, cognition, and affect, including the refinement of instrumentation, would help elucidate the best methods to facilitate learning in a zoo context.

APPENDIX A
INFORMED CONSENT FORM

Kerry Ann Carlin
Dept. of Instruction and Curriculum, 258 Norman Hall
University of Florida

January 5, 1999

Dear Parents/Guardians:

I am a graduate student in the College of Education at the University of Florida under the supervision of Dr. Mary Kantowski. As part of my dissertation research, I am conducting a study to investigate what and how elementary aged visitors learn at the zoo. Participants in this study will visit the Lowry Park zoo as one of their regularly scheduled school field trips.

Before and after the visit, participants in this study will be asked to take tests designed for this research. During school hours and on school grounds, they will be asked to answer questions on five different tests. The teacher or I will explain the directions for each test to the participants and then give them as much time as needed to answer the questions. Participants do not have to answer any questions that they do not wish to. Taking all the tests will take approximately an hour. Three days after the visit, participants will be asked to take the test again using the same procedures. Students who are not part of the study will participate in activities chosen by their teachers.

During the visit, other graduate students and myself will observe students. The following information will be recorded: how much time they spend at an exhibit, how they interact with the exhibit, and what comments they make and questions they ask about the exhibits. Students will be unobtrusively observed so that their trip is not disturbed.

I am asking you to permit your child to participate in my research. It is anticipated that there will be no risks in taking part in this study. There are also no direct benefits or compensation for your child. This is a voluntary study, so you may withdraw your child, or s/he may withdraw her/himself, from the study at any time without penalty or prejudice to you or to her/him. It is preferable, however, that s/he takes part in the entire study. Participation or nonparticipation in this study will not directly affect her/his grade in any classes.

In addition, I would also like to have your permission to obtain, from school records, your child's gender and race. All information will be numerically coded and completely confidential. No student names will be used in reporting the study findings. The list with numerical codes and names will be destroyed at the end of the study. I will be the only one to see individual results of the tests. Group scores and averages will be shared with my committee.

If you have any concerns at any time during the study, please call me at 373-2117 or you may contact my supervisor, Dr Kantowski at 392-0761 ext. 200. Questions or concerns about research participants' rights can be directed to the UFIRB Office, PO Box 112250, University of Florida, Gainesville, FL, 32611-2250.

Your help with my research is greatly appreciated. Please sign the permission slip at the bottom of this letter and return it to your child's teacher. Thank you for your cooperation.

Sincerely,

Kerry A. Carlin

I have read the procedure described above and I voluntarily agree to allow my child, _____________________________, to participate in Kerry A. Carlin's study at the Lowery Park Zoo.

Signatures:

Parent/Guardian	Date	Parent/Guardian	Date

APPENDIX B
ZOO EPISTEMIC CURIOSITY SCALE

<u>Worksheet 1</u>

Name: ____________________ Date: __________

Directions: Listed below are sentences people use to describe themselves. Read each sentence. Then on a scale from 1 – 5; with 1 being not all and 5 being very much, circle the answer you think best describes how you would feel while learning about new zoo animals. This **is not** a test. You **will not** be graded. Do not spend too long on each question. Pick the answer that seems to describe how you would feel.

	No, Not at all				Yes, Very Much
1. The animals at the zoo are very interesting to me.	1	2	3	4	5
2. I enjoy learning about zoo animals that are new to me.	1	2	3	4	5
3. I feel that the zoo is boring	1	2	3	4	5
4. At the zoo, I enjoy reading about new animals.	1	2	3	4	5
5. I like learning about zoo animals when it is hard.	1	2	3	4	5
6. I think it is fun to understand more about the zoo animals.	1	2	3	4	5
7. I like to learn more about the animals than I am told at the zoo.	1	2	3	4	5
8. I enjoy learning new words about the zoo animals.	1	2	3	4	5
9. Sometimes it is hard to think for a long time about zoo animals.	1	2	3	4	5
10. It is interesting to me to learn new information about zoo animals.	1	2	3	4	5
11. I am not interested if the information about the zoo animals is too hard.	1	2	3	4	5

	No, Not at all				Yes, Very Much
12. When I read a sentence about a zoo animal that I do not understand, I keep reading it until I understand it.	1	2	3	4	5
13. I like learning new material about zoo animals that surprises me and makes me have new ideas.	1	2	3	4	5
14. It is more fun for me to read new information about zoo animals than to read information I already know.	1	2	3	4	5
15. It is easy to pay attention to hard material about the zoo animals.	1	2	3	4	5
16. The information at the zoo about the animals makes me think of new ideas.	1	2	3	4	5
17. I like to answer difficult questions about the zoo animals rather than easy ones.	1	2	3	4	5
18. At the zoo, when I come across something I don't understand about the animals, I try to figure it out.	1	2	3	4	5
19. It is exciting to me to learn about the animals at the zoo.	1	2	3	4	5
20. I get bored if the material at the zoo is repeated.	1	2	3	4	5
21. I will learn something new at the zoo	1	2	3	4	5

APPENDIX C
COGNITIVE MEASURE

Name: ________________________ Worksheet 2

Write down all the words that you can think of when you think about a trip to the zoo. If you need more room, write on the back of the page. **This is not a test.** You will not be graded on it.

Trip to the zoo.

APPENDIX D
AFFECTIVE MEASURE

Name: ____________________ Worksheet 3

1. What is your favorite animal at the zoo? ____________________

   Why is it your favorite animal?

2. What animal at the zoo do you like least? ____________________

   Why don't you like it?

3. Have you ever been to the Lowery Park Zoo before? Yes or No

   About how many times?

REFERENCES

Adams, C.E., Newgard, L. & Thomas, J.K. (1986). How high school and college students feel about wildlife: Implications for curriculum development. The American Biology Teacher, 48(5), 263-267.

Alberti, E.T. & Witryol, S.L. (1994). The relationship between curiosity and cognitive ability in third and fifth grade children. The Journal of Genetic Psychology, 155 (2), 129-145.

Altman, J.D. (1990). The effect of zoo animal activity on animal well-being, human learning, and zoo animal – visitor interaction. Unpublished Dissertation, Temple University, Philadelphia, PA.

Arnone, M.P., Grabowski, B.L. & Rynd, C.P. (1994). Curiosity as a personality variable influencing learning in a learner controlled lesson with and without advisement. Educational Technology, Research, & Development, 42(1), 5-20.

Arnone, M.P. & Small, R.V. (1995). Arousing and sustaining curiosity: Lessons from the ARCS model. (ERIC Reproduction Service No. 383 285)

Balling, J.D. & Falk, J.H. (1982). A perspective on field trips: Environmental effects on learning. Curator, 23(4), 229-240.

Balling, J.D., Falk, J.H., Aronson, R., White, J., Herman, J. & O'Connell, R.A. (1981). Improving the quality of single-visit field trips to the National Zoological Park. Museum Roundtable Reports, 7(4), 19-20.

Bart, W.M. (1972). A hierarchy among attitudes towards animals. The Journal of Environmental Education, 3(4), 4-6.

Berkovitz, A. (1988). The zoo as Noah's ark, In Druger, M. (Ed.), Science for the fun of it: A guide to informal science education (pp. 70-77). (ERIC Document Reproduction Service No. ED 303 318)

Berlyne, D.E. (1954). A theory of human curiosity. British Journal of Psychology, 45, 180-191.

Berlyne, D.E. (1966a). Conflict and arousal. Scientific American, 215, 82-87.

Berlyne, D.E. (1966b). Curiosity and exploration. Science, 153, 25-33.

Berlyne, D. (1978). Curiosity and Learning. Motivation and Emotion, 2, 97-175.

Bevins, R.A. & Bitgood, S. (1989). Developing a device to assess attitudes toward snakes. In S. Bitgood, A. Benefield, & D. Patterson (Eds.), Visitor Studies: theory, research, and practice volume 2 (pp. 123-130). Jacksonville, AL: Center for Social Design.

Birney, B.A. (1986). A comparative study ofchildren's perceptions and knowledge of wildlife and conservation as they relate to field trip experiences at the Los Angeles County Museum of Natural History and the Los Angles Zoo. Unpublished Dissertation, University of California, Los Angeles, CA.

Birney, B. & Heinrich, C. (1991). Understanding demographic data on zoo visitors. Journal of Museum Education, 16(2), 19-22.

Birney, B. & Shaha, S. (1982). Dosage versus distribution: The support of docents on zoo visitor's acquisition of knowledge. (ERIC Document Reproduction Service No. ED 226 995)

Bitgood, S., Patterson, D. & Benefield, A. (1986). Understanding your visitors: then factors that influence visitor behavior. Technical Report # 86-60 Jacksonville State University, Jacksonville, AL.

Bixler, B.C. (1995). A survey of the present status and potential future of conservation education programs existing at zoos and aquariums throughout the United States and Canada. Unpublished Master's Thesis, University of Georgia, Athens, GA.

Blakely, R.L. (1981). Formulating an exhibit: An exhibit philosophy. International Zoo Yearbook, 21, 1-5.

Blyth, C. (1971). Education programs at the Los Angeles County Zoo. International Zoo Yearbook, 11, 157-158.

Bradbard, M.R. & Endsley, R.C. (1980). How do teachers develop young children's curiosity?: What current research says to teachers. Young Children, 35(5), 21-31.

Bradbard, M.R., Halperin, S.M. & Endsley, R.C. (1988). The curiosity of abused preschool children in mother-present, teacher-present, and stranger-present situations. Early Childhood Research Quarterly, 3, 91-105.

Bransford, J.D. (1979). Human cognition: Learning, understanding, and remembering. Belmont, CA: Wadsworth.

Braverman, M.T. & Yates, M.E. (1989). Enhancing the educational effectiveness of zoos. (ERIC Document Reproduction Service No. ED 306 132)

Brereton, A. (1968). Education: A primary function of the San Diego Zoo. International Zoo Yearbook, 8, 173-174.

Cantor, I.B. (1976). Naturalistic observation of curiosity behavior in kindergarten children. Unpublished Doctoral Dissertation, State University of New Jersey, New Brunswick, NJ.

Camp, B.D. (1996). Orientation to objects by African American and white adolescents in an informal setting. Unpublished Doctoral Dissertation, University of Florida, Gainesville, FL.

Catherwood, D. (1988). Sensorimotor exploration of a novel object by Aboriginal and Caucasian children. Early Child Development and Care, 39, 67-75.

Ceci, S.J. & Bronfenbrenner, U. (1985). "Don't forget to take the cupcakes out of the oven": Prospective memory, strategic time-monitoring, and context. Child Development, 56, 152-164.

Churchman, D. (1985). The educational impact of zoos and museums: A review of the literature. (ERIC Reproduction Service No. ED 259 912)

Churchman, D. (1987). The education roles of zoos: A synthesis of the literature (1927-1987) with annotated bibliography. (ERIC Document Reproduction Service No. ED 289 742)

Coie, J.D. (1974). An evaluation of the cross-situational stability of children's curiosity. Journal of Personality, 42, 93-116.

Collins, M.A.J. (1976). Student attitudes towards animals. The American Biology Teacher,38(8), 491-493.

Conway, W. (1969). Zoos: Their changing roles. Science, 161, 48-52.

Cronbach, L.J. & Snow, R.E. (1977). Aptitudes and Instructional Methods. New York: Irvington Press.

Dathe, H. & Zwirner, F. (1974). The education department at Tierpark Berlin. International Zoo Yearbook, 14, 250-251.

David, D.B. & Witryol, S.L. (1989). Gender as a moderator variable in the relationship between an intrinsic motivation scale and short-term novelty in children. The Journal of Genetic Psychology, 151(2), 153-167.

Day, H.I. (1982). Curiosity and the interested explorer. NSPI Journal, May, 19-22.

DeKlerk, L.F. (1987). The role of prior experience in learning from instruction. (ERIC Document Reproduction Services No. ED 286 931)

Dochy, F.J. (1990). Instructional implications of recent research and empirically based theories on the effect of prior knowledge on learning. In J.M. Pieters, & K. Breuer (Eds.), Learning Environments (Research in Psychology Series). (pp 337- 355). Berlin, Germany: Springer-Verlag.

Eagles, P.F.J. & Muffitt, S. (1990). An analysis of children's attitudes toward animals. Journal of Environmental Education, 21(3), 41-44.

Ellis, J., Koran, J.J. & Koran, M.L. (1991). Visitor learning in museums - curiosity and human development theories: Implications for museum programs and exhibit design. Museum Studies Program. Review of Current Research, volume 1. (ERIC Document Reproduction Service No. ED 337 401)

Endsley, R.C., Hutcherson, M.A., Garner, A.P. & Martin, M.J. (1979). Interrelationships among selected maternal behaviors, authoritarianism, preschool children's vocabulary, and nonverbal curiosity. Child Development, 50, 331-339.

Engelhard, G (1985). The discovery of educational goals and outcomes: A view of the latent curriculum of schooling. Unpublished Doctoral Dissertation, University of Chicago, Chicago, IL.

Engelhard, G. & Monsaas, J.A. (1988). Grade level, gender, and school-related curiosity in urban elementary schools. Journal of Educational Research, 82(1), 22-26.

Falk, J.H. (1983). Time and behavior as predictors of learning. Science Education, 67(2), 267-276.

Falk, J.H. & Dierking, L.D. (1992). The Museum Experience. Washington DC: Whalesback Books.

Falk, J.H. & Dierking, L.D. (1997). School field trips: Assessing their long-term impact. Curator, 40(3), 211-218.

Falk, J.H., Martin, W.W. & Balling, J.D. (1978). The novel field-trip phenomenon: Adjustment to novel settings interferes with task learning. Journal of Research in Science Teaching, 68(2), 124-134.

Falk, J.H., Moussouri, T. & Coulson, D. (1998). The effect of visitor's agendas on museum learning. Curator, 41(2), 107-120.

Farmer, A.J. & Wott, A.A. (1995). Field trips and follow-up activities: Fourth graders in a public garden. Journal of Environmental Education, 27(1), 33-35.

Fire, W.M. (1985). Interaction of cues, learner curiosity, verbal ability, and amount of invested mental effort with achievement in a museum setting. Unpublished Doctoral Dissertation, University of Florida, Gainesville, FL.

Foster, J.S., Koran, J.J., Koran, M.L., Stark, S., Blackwood, A. & Landers, H. (1988). The effect of multispecies exhibits on visitor attention at the Jacksonville Zoological Park. In S. Bitgood, J.T. Roeper, & A. Benefield (Eds.), Visitor studies: Theory, research, & practice, volume 1 (pp. 113-199). Jacksonville, AL: Center for Social Design.

Garner, R. (1990). When children and adults do not use learning strategies: Toward a theory of settings. Review of Educational Research, 60(4), 517-529.

Gold, S.R. & Henderson, B.B. (1990). Daydreaming and curiosity: stability and change in gifted children and adolescents. Adolescence, 25(99), 701-708.

Goldstein, S.P. (1986). The gifted child: An investigation of science achievement with respect to spatial ability, science interest, curiosity, level of giftedness, and sex of child. Unpublished Doctoral Dissertation, George Washington University, Washington DC.

Gottfried, J.F. (1980). A naturalistic study of children's behavior in a free-choice learning environment. Unpublished Doctoral Dissertation, University of California, Berkeley, CA.

Gugula, M.L. (1980). The relationship between anxiety, curiosity, and intelligence among sixth-grade students. Unpublished Dissertation, State University of New Jersey, New Brunswick, NJ.

Harty, H. & Beall, D. (1984). Toward the development of a children's curiosity measure. Journal of Research in Science Teaching, 21(4), 425-436.

Harty, H. & Beall, D. (1985). Reactive curiosity of gifted and nongifted elementary school youngsters. Roeper Review, 7(4), 214-217.

Henderson, B. & Moore, S.G. (1979). Measuring exploratory behavior in young children: A factor-analytic study. Developmental Psychology, 15(2), 113-119.

Henderson, B. & Moore, S.G. (1980). Children's responses to objects differing in novelty in relation to level of curiosity and adult behavior. Child Development, 51, 457-465.

Henderson, B.B. & Wilson, S.E. (1991). Intelligence and curiosity in preschool children. Journal of School Psychology, 29, 167-175.

Hoke, M.W. (1991). Field-trip tips – A baker's dozen. Science and Children, 28(7), 20-21.

Holzer, D., Scott, D. & Bixler, R. (1997). The long-lasting effects of early zoo visits. Curator, 40(4), 255-256.

Hutt C. (1970). Specific and diversive exploration. In H.W. Reese & L.P. Lipsitt (Eds.), Advances in child development and behavior volume 5 (pp. 120-172). San Diego: Academic Press.

Inagaki, K. (1978). Effects of object curiosity on exploratory learning in young children. Psychological Reports, 42, 899-908.

Jenkins, J.A. (1969). An experimental investigation of the effect of structured science experiences on curiosity among fourth grade children. Journal of Research in Science Teaching, 6, 128-135.

Johns, C. & Endsley, R.C. (1977). The effects of a maternal model on young children's tactual curiosity. The Journal of Genetic Psychology, 131, 21-28.

Jones, R.S. (1979). Curiosity and knowledge. Psychological Reports, 45, 639-642.

Keating, B. (1986). The zoo's role in the world conservation strategy. Paper presented at the meeting of the International Association of Zoo Educators, Melbourne, Australia.

Kellert, S.R. (1985). Attitudes toward animals: Age-related development among children. The Journal of Environmental Education, 16(3), 29-39.

Kempa, R.F. & Diaz, M. (1990). Students' motivational traits and preferences for different instructional modes in science education – Part 2. International Journal of Science and Education, 12(2), 205-216.

Kidd, A.H., Kidd, R.M. & Zasloff, R.L. (1995). Developmental factors in positive attitudes toward zoo animals. Psychological Reports, 76, 71-81.

Kinville, C. (1968). Oklahoma City zoo's education program. International Zoo Yearbook, 8, 171-172.

Koran, J.J., Foster, J.S. & Koran, M.L. (1989). The relationship among interest, attention, and learning in a natural history museum. In S. Bitgood, A. Benefield, & D.Patterson (Eds.), Visitor studies: Theory, research, and practice, volume 2 (pp. 239-244). Jacksonville, AL: Center for Social Design.

Koran, J.J. & Koran, M.L. (1986a). A proposed framework for exploring museum education research. Roundtable Reports, 11(1), 12-16.

Koran, J.J. & Koran, M.L. (1986b). The roles of attention and curiosity in museum learning. Roundtable Reports, 8(2), 14-18.

Koran, J.J., Koran, M.L. & Foster, J.S. (1989). Individual differences in learning from informal settings. In S. Bitgood, J.T. Roeper, & A. Benefield (Eds.), Visitor studies: Theory, research, and practice, volume 2 (pp. 66-72). Jacksonville, AL: Center for Social Design.

Koran, J.J., Koran, M.L., Foster, J.S. & Fire, W.M. (1989). Curiosity, verbal ability, and learning concepts in biology. School Science and Mathematics, 89(5), 405-411.

Koran, J.J., Koran, M.L. & Longino S.J. (1984). The relationship of age, sex, attention, and holding power with two types of science exhibits. Curator, 29, 227-235.

Koran, J.J. & Longino, S.J., (1982). Curiosity and children's science learning. Science and Children, 20, 18-19.

Koran, J.J., Morrison, L., Lehman, J.R., Koran, M.L. & Gandara, L. (1984). Attention and curiosity in museums. Journal of Research in Science Teaching, 21, 357-363.

Koran, J.J. & Schafer, L. (1982). Learning science in informal settings outside the classroom. In M.B. Rowe (Ed.), Education in the 80's: Science (pp. 52-62). Washington DC: National Education Association.

Koran, M.L. & Koran, J.J. (1984). Aptitude-treatment interaction research in science education. Journal of Research in Science Teaching, 21(8), 793-808.

Kreitler, S., Zigler, E. & Kreitler, H. (1975). The nature of curiosity in children. Journal of School Psychology, 13(3), 185-200.

Kress, S.W. (1975). A study of the modification of children's negative attitudes toward animals. Unpublished Doctoral Dissertation, Cornell University, Ithaca, NY.

Kubota, C.A. & Olstad, R.G. (1991). Effects of novelty-reducing preparation on exploratory behavior and cognitive learning in a science museum setting. Journal of Research in Science Teaching, 28(3), 225-234.

Leherissey, B.L. (1971). The development of a measure of state epistemic curiosity. (ERIC Document Reproduction Service No. ED 053 549)

Lessow, D.E. (1990). Visitor perceptions of natural habitat zoo exhibits. Unpublished Doctoral Dissertation, Indiana University, Bloomington, IN.

Libutti, P. (1978). Peer facilitation of curiosity and exploratory behavior. Unpublished Doctoral Dissertation, Temple University, Philadelphia, PA.

Litwak, J.M. (1992). Enhancing Museum learning by facilitating the visitor social agenda. In S. Bitgood, A. Benefield, & H. Shettel (Eds.), Visitor Studies: Research, Theory, & Practice volume 5 (pp. 111-115). Jacksonville, AL: Center for Social Design.

Lowenstein, G. (1994). The psychology of curiosity: A review and reinterpretation. Psychological Bulletin, 116(1), 75-98.

Lowry, N. & Johnson, D.W. (1981). Effects of controversy on epistemic curiosity, achievement, and attitudes. The Journal of Social Psychology, 115, 31-43.

Maccoby, E.E. & Jacklin, C.N. (1974). The psychology of sex differences. Stanford, CA: Stanford University Press.

Marcellini, J. (1976). Reptile house tracking study. Unpublished paper. Washington DC, Smithsonian Institute.

Marsh, C. (1978). Social-psychological influences upon the expression and inhibition of curiosity. Unpublished Doctoral Dissertation, George Washington University, Washington DC.

Marshdoyle, E., Bowman, J.L. & Mullins, G.W. (1982). Evaluating programmatic use of a community resource: The zoo. Journal of Environmental Education, 13(4), 19-26.

Maw, W. & Maw, E. (1961). Information recognition by children with high and low curiosity. Educational Research Bulletin, 40, 197.

Maw, W. & Maw, E. (1964). An exploratory study into the measurement of curiosity in elementary school children. Cooperative Research Project No. 801. Washington DC.: Department of Health, Education, and Welfare

Maw, W. & Maw, E. (1965). Differences in preference for investigatory activities by school children who differ in curiosity level. Psychology in the Schools, 2, 262-266.

McGuire, C. & Rowland, T. (1966). Curiosity in the educational encounter: A representation of Daniel E. Berlyne. (ERIC Document Reproduction Services No. ED 013 987)

Messick, S. (1979). Potential uses of non-cognitive measurement in education. Journal of Educational Psychology, 71(3), 281-292.

Milan, L.M. (1995). Leisure education: An application of learning style theory to zoo visitors. Unpublished Doctoral Dissertation, City University of New York, New York, NY.

Moch, M. (1987). Asking questions: An expression of epistemological curiosity in children. In J.F. Wohwill & D. Gorlitz (Eds.), Curiosity, imagination, and play: On the development of spontaneous cognitive and motivational processes (pp. 199-211). Hillsdale, NJ: Erlbaum.

Morris, D. (1960). An analysis of animal popularity. International Zoo Yearbook, 2, 60-61.

Mueller, D.J. (1986). Measuring social attitudes: A handbook for researchers and practitioners. New York: Teachers College Press.

Neal, E. (1970). A review of epistemic curiosity and behavior. Educational Leadership, 27(6), 633-637.

Novak, J.D., & Gowin, D.B. (1991). Learning how to learn. Cambridge: Cambridge University Press

Nunnally, J.C. & Lemond, L.C. (1973). Exploratory behavior and human development. In H.W. Reese (Ed), Advances in child development and behavior volume 8 (pp. 59-107). New York: Academic Press.

Paradowski, W. (1967). Effect of curiosity on incidental learning. Journal of Educational Psychology, 58(1), 50-55.

Parsons, C. & Muhs, K. (1996). Field trips and parent chaperones: A study of self-guided school groups at the Monterey Bay Aquarium. In S. Bitgood, A. Benefield, & H. Shettel (Eds.), Visitors Studies: Theory, Research, and Practice, Selected Papers from the 1994 Visitor Studies Conference, 7(1), 57-61.

Perry, D.L. (1993). Beyond cognition and affect: The anatomy of a museum visit. In S. Bitgood, A. Benefield, & H. Shettel (Eds.), Visitor Studies: Research, Theory, & Practice volume 6 (pp. 43-47). Jacksonville, AL: Center for Social Design.

Peterson, R.W. (1979). Changes in curiosity behavior from childhood to adolescence. Journal of Research in Science Teaching, 16(3), 185-192.

Peterson, R.W. & Lowery, L.F. (1972). The use of motor activity as an index of curiosity in children. Journal of Research in Science Teaching, 9(3), 193-200.

Pielstick, N.L. & Woodruff, A.B. (1964). Exploratory behavior and curiosity in two age and ability groups of children, Psychological Reports, 14, 831.

Prather, J.P. (1989). Review of the value of field trips in science instruction. Journal of Elementary Science Education, 1(1), 10-17.

Price, E.C., Ashmore, L.A. & McGivern, A.M. (1994). Reactions to zoo visitors to free-ranging monkeys. Zoo Biology, 13, 355-373.

Rabinowitz, F.M., Moely, B.E. & Findel, N. (1975). The effects of toy novelty and social interaction on the exploratory behavior of preschool children. Child Development, 46, 286-289.

Rajecki, D.W. (1982). Aptitudes, themes, and advances. Sunderland, MA: Sinaer Associates.

Ramey-Gassert, L., Walberg, H.J. & Walberg, H.J. (1994). Reexamining connections: Museums as science learning environments. Science Education, 78(4), 345-363.

Rembold, K.L. & Yussen, S.R. (1986). Interrelationship of knowledge, learning, and development. (ERIC Document Reproduction Services No. ED 275 768)

Rennie, L.J. & McClafferty, T. (1995). Using visits to interactive science and technology centers, museums, aquaria, and zoos to promote learning in science. Journal of Science Teacher Education, 6(4), 175-185.

Ronkeach, M. (1970). Beliefs, attitudes, and values. San Francisco, CA: Jossey-Bass.

Rotto, L.I. (1994). Curiosity, motivation, and "flow" in computer based instruction. (ERIC Document Reproduction No. ED 373 755)

Sanford, F. (1984). Modern zoos: New Challenges, new responsibilities. The American Biology Teacher, 46(1), 36-40.

Schnackenberg, H.L., Saveyne, W.C. & Jones, H. (1997). View the zoo! Evaluation of visual communication in an outdoor educational setting. (ERIC Reproduction Service No. ED 403 879)

Schneider, K. (1987). Subjective uncertainty and exploratory behavior in preschool children. In D. Gorlitz & J.F. Wohlwill (Eds), Curiosity, imagination and play: On the development of spontaneous cognitive and motivational processes. (pp. 180-197). Hillsdale, NJ: Erlbaum.

Shavelson, R.J. (1988). Statistical reasoning for the behavioral sciences. Boston: Allyn and Bacon.

Sherif, C. & Sherif, M. (1967). Attitude, ego involvement, and change. New York: John Wiley.

Sherwood, K.P., Rallis, S.F. & Stone, J. (1988). Effects of live animals vs. preserved specimens on student learning. Zoo Biology, 8, 99-104.

Shettel, H.H., Butcher, M., Cotton, T.S., Northrup, J. & Slough, D.C. (1968). Strategies for determining exhibit effectiveness. (Project No. V –011) Pittsburgh, PA: American Institutes for Research (ERIC Reproduction Service No. ED 026 713)

Shore, L.S. (1996). Developing gender equality at home: The influence of the exploratorium "Science at Home" project on parental attitudes, perceptions, and behaviors. (ERIC Document Reproduction Service No. ED 394 834)

Shumakova, N. (1992). Study of student's curiosity. Roeper Review, 14(4), 197.

Singh, A.K. & Sinha, K. (1990). Personality characteristics of socially advantaged and socially disadvantaged children. Indian Journal of Psychometry and Education, 21(2), 81-86.

Smock, C.D. & Holt, B.G. (1962). Children's reactions to novelty: An experimental study of "curiosity motivation". Child Development, 33, 631-642.

Smyth, J. (1984). Environmental education and the International Union for the Conservation of Nature and Natural Resources. Paper presented at the International Association of Zoo Educators, Edinburgh, Scotland.

Spielberger, C.D. & Starr, L.M. (1994). Curiosity and exploratory behavior. In H.F. O'Neil & M. Drillings (Eds.), Motivation: Theory and practice (pp. 221-241). Hillsdale, NJ: Erlbaum.

Stoneburg, S.A. (1981). The effects of pre-visit, on-site, and post-visit zoo activities upon the cognitive achievement and attitudes of sixth grade pupils. Unpublished Doctoral Dissertation, University of Minnesota, Duluth, MN.

Surinova, M. (1971). An analysis of the popularity of animals. International Zoo Yearbook, 11, 165-167.

Sussman, R. (1989). Curiosity and exploration in children: Where affect and cognition meet. In K. Field, J.C. Bertram & W. Glorye (Eds.), Learning and education: Psychoanalytic perspectives (pp. 246-266). Madison, CT: International Universities Press.

Thomson, B.S. & Diem, J.J. (1994). Fruit bats, cats, and naked mole rats: Lifelong learning at the zoo. (ERIC Reproduction Service No. ED 372 966)

Torrance, E.P. (1970). Freedom to manipulate objects and question-asking performance of six-year-olds. Young Children, 26, 93-97.

Tunnicliffe, S.D. (1998). Boy talk/girl talk: Is it the same at animal exhibits?. International Journal of Science Education, 20(7), 795-811.

Vidler, D.C. (1977). Curiosity. In S. Ball (Ed), Motivation in education (pp. 17-39). New York: Academic Press.

Westervelt, M.O. & Llewellyn, L.G. (1985). Youth and wildlife: The beliefs and behaviors of fifth and sixth grade students regarding non-domestic animals. (ERIC Reproduction Services No. ED 302 379)

Wineman, J., Piper, C. & Maple, T.L. (1996). Zoos in transition: Enriching conservation education for a new generation. Curator, 39(2), 94-107.

Zipko, S.J. (1974). The reasons for outdoor education. Science Activities, 31-33.

BIOGRAPHICAL SKETCH

Kerry Carlin was born in 1969 in Brooklyn, New York. At the age of seven, her parents moved to Long Island, New York, where she grew up. She attended Adelphi University in Garden City, New York, for three years. In 1991, she transferred to the University of Florida where she received her Bachelor of Science degree in Animal Science and her Master of Science degree in Education. While an undergraduate at the University of Florida, she volunteered as a docent for the Jacksonville Zoological Gardens in Jacksonville, Florida. This is where she discovered the wonderful field of science education in informal settings. While exploring education and career options, she met Dr. John Koran, who inspired her into pursuing her Ph.D. During her graduate career, Ms. Carlin had the opportunity to work in a wide variety of institutions such as the Silver Springs Museum and Environmental Education Center, Silver Springs Attraction, the Brookfield Zoo, The Florida Game and Fresh Water Fish Commission, and the Florida Museum of Natural History. Ms. Carlin will be moving to Athens, Georgia, with her husband, Michael, and their numerous pets where she will become the new Curator of Exhibits and Outreach for the Georgia Museum of Natural History at the University of Georgia.

I certify that I have read this study and that in my opinion it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Eleanore Kantowski

Eleanore Kantowski, Chairman
Professor of Instruction and Curriculum

I certify that I have read this study and that in my opinion it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Mary Lou Koran

Mary Lou Koran
Professor of Foundations of Education

I certify that I have read this study and that in my opinion it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

M. David Miller

M. David Miller
Professor of Foundations of Education

I certify that I have read this study and that in my opinion it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Linda A. Behar-Horenstein

Linda Behar-Horenstein
Associate Professor of Educational Leadership

I certify that I have read this study and that in my opinion it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Susan K. Jacobson
Associate Professor of Wildlife Ecology and Conservation

This dissertation was submitted to the Graduate Faculty of the College of Education and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 1999

Roderick J. McDavis

Dean, College of Education

Dean, Graduate School